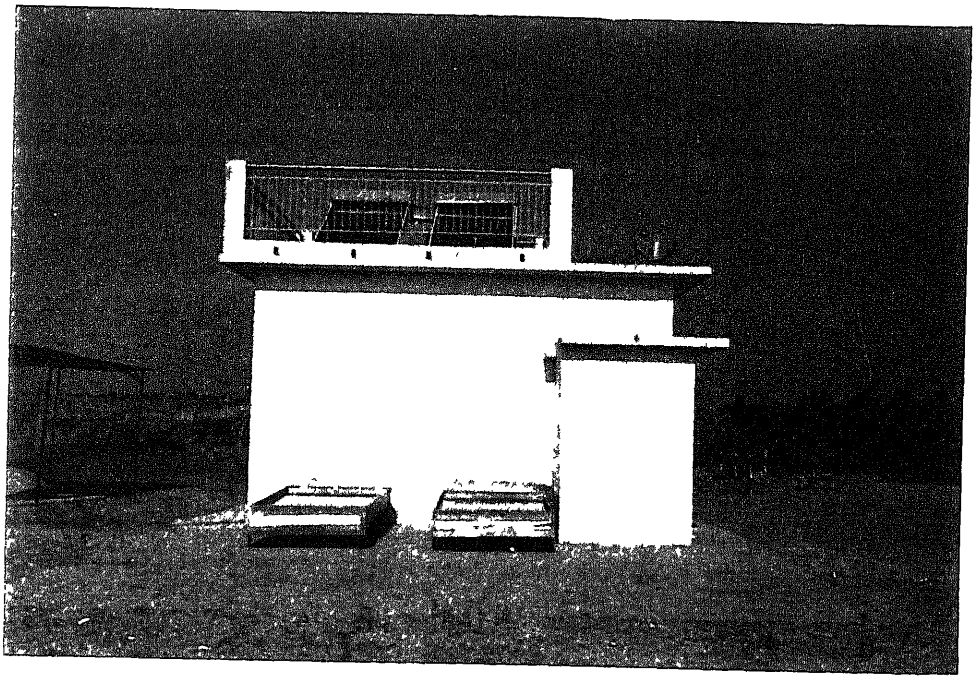
Development of a Solar Double Chimney Cooling and Heating System for Thermal Conditioning of Buildings in Composite Climates

Final Report

Submitted to

Ministry of Non-conventional Energy Sources
Block No. 14, C.G.O. Complex
Lodi Road, New Delhi - 110 003.



Submitted by

Tata Energy Research Institute
Darbari Seth Block
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Lodi Road, New Delhi - 110 003.

October 1994

TERI
GR 7002

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1 "Solar double chimney system for thermal conditioning of buildings in composite climates" by P Raman, Sanjay Mande and V V N Kishore presented at National Solar Energy Convention 1991 (NSEC-91), December 16-18, 1991, Pune.

2 "Estimation of air flow rate handled by solar chimneys" by Sanjay Mande, P Raman and V V N Kishore presented at National Solar Energy Convention 1991 (NSEC-91), December 16-18, 1991, Pune

3 "Modelling of room air cooler utilizing solar double chimney" by Sanjay Mande, P Raman and V V.N Kishore presented at Seminar on Energy Conservation in Buildings (SECIB-92), November 12-14, 1992, Roorkee

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Nomenclature

A = Cross sectional area
A_c = Collector area
A_f = Flow area
C = Heat capacity rate
C_d = Unitary heat load of building
$C_{p\,air}$ = Specific heat of air
D_H = Hydraulic diameter
F' = Collector efficiency factor
f = Friction factor
g = Acceleration due to gravity
Gr = Grashoff number
h = Heat transfer coefficient
I = Solar radiation intensity on the collector surface
k = Thermal conductivity
K = Loss coefficient at duct opening
L_c = Length of solar chimney, characteristic length
m = Mass flow rate of air
M_{air} = Molecular weight of air
Nu = Nusselt number
P_{atm}, P_{air} = Atmospheric pressure
Pr = Prandtl number
Ps = Saturation pressure of water vapour
P_w = Partial pressure of water vapour
Q = Heat transfer rate
R = Universal gas constant
Re = Reynolds number
T = Temperature
U_L = Overall heat loss coefficient of collector
V = Velocity of air
w = Specific humidity
W_c = Width of collector
β = Collector inclination angle
λ = Latent heat of vaporization
ϕ = Relative humidity
η_c = Collector efficiency
ρ = Density of air
σ = Stefan Boltzman constant
$\tau\alpha$ = Effective transmitivity-absorptivity product

Subscripts

1 = Inlet
2 = Outlet
a, air = Air
a,1 = Bottom chimney air
a,2 = Top chimney air
avg = Average

c = Convection
e = Evaporation
f = Water film surface
r = Room
ref = Reference
s = Humid air

1.0 Summary

The overriding objective of the present project is to design, develop, fabricate and demonstrate a novel solar passive design concept using 'solar double chimney cooling and heating system' for thermal conditioning of buildings in composite climate

In the original proposal [1] of the project submitted to MNES (Ministry of Non-conventional Energy Sources) in 1990, the following objectives were spelt out

- to design and develop a new system by integrating some of the well known passive solar concepts, intended for the large central and northern regions of India where composite climatic conditions exist
- to construct a prototype building with the above system and monitor its functioning
- to introduce further modifications in the system to arrive at optimum operating conditions
- to develop a computer model for the system components
- to demonstrate the actual functioning of the system

All the above objectives have been achieved

In the original proposal, construction of two identical buildings was suggested, so that one can act as a reference building while in the other building proposed system can be installed to see the level of improvement in the thermal condition of the building due to installation of the proposed system But, MNES suggested to carry out the project with the help of existing building structures at TERI's Gual Pahari campus in Haryana This project report describes the system concept, prototype system development at TERI's Gual Pahari Campus, alongwith details of the computer model developed for solar chimney and room air cooling component of the system The performance of the system has been monitored for one complete calendar year and achievements are described and analyzed Based on the experience gained through performance monitoring of the system, an improved system is suggested for future R&D activity in this area

2.0 Introduction

The primary role of buildings is to protect the mankind from the extremities of climates The entire history of shelter engineering reveals the unremitting effort of the human race to find adequate building designs to which man is best adapted Traditional buildings, therefore were built with considerations to climatic conditions for keeping the inside building spaces cool in summer and warm in winter These aspects have been forgotten in the modern architecture which essentially relies on mechanical methods of heating and cooling involving large amount of energy expense With the growing energy crisis and with growing awareness about the environment, there is renewed interest on those aspects of architecture which lead to thermal comfort in buildings without any expenditure of conventional energy These aspects are termed as solar passive building science and design

Ancient architecture had many passive features which helped in creating comfortable thermal environment in the buildings The buildings were shaped and different parts of the building (windows, doors, indoor spaces etc) located and oriented to take maximum advantage of the climate The role of trees, vegetation and water around the building in determining the thermal comfort was also well appreciated The Greeks realized the importance of south wall (in northern hemisphere), Socrates (400 BC) said that we should build the south side loftier to get the winter sun and the north side lower to keep out the cold winds In hot and dry climates of Rajasthan (India), characterized by high day time temperatures and uncomfortable low night temperatures, the thick walls made of mud and stones increases the thermal lag period, thereby delaying heat transfer into the building by such a period that it reached the interior during night when it is least bothersome (or often welcome) Ancient Iranian architecture exploited the concepts of building clusters (for decreasing surface to volume ratio), thick walls (for increasing thermal storage and smoothening temperature fluctuations), plantations for shading and large thermal storage capacity of the ground (by building underground) Iranians also used the concept of wind towers, which along with cooling of the air by earth and water evaporation kept the buildings comfortable in summer [2].

2.1 Passive building concepts

A systematic study of different rural buildings in various climatic zones has led to the identification of the following concepts for passive building design

(a) Heating

(i) Increase of solar heat gain

- Orientation

- Reflecting components
- Absorbing surfaces
- Glazing

(ii) **Reduction of heat loss**

- Minimum surface to volume ratio
- Thermal insulation
- Reduction of air infiltration
- Wind shelter

(iii) **Increase of internal heat gain**

- Living organism
- Condensation

(iv) **Heat storage**

- Direct gain
- Indirect gain
- Rock bed

(b) Cooling

(i) **Reduction of solar and convective heat input**

- Orientation
- Shading by neighbouring building
- Shading by vegetation
- Shading by overhangs textured facades
- Reflecting surfaces
- Shelter against hot winds

(ii) **Reduction of heat transmission**

- Thermal insulation
- Air cavities

(iii) **Increase of heat loss by radiation**

- Enlarged surface area
- Movable elements

(iv) **Increase of heat loss by convection**

- Outdoor wind management
- Indoor natural ventilation
- Indoor forced ventilation
- Earth air tunnel flowing water

(v) **Increase of heat loss by evaporation**

- Outdoor air cooling indoor air cooling
- Building surface cooling

(vi) **Thermal storage**

- Building elements
- Earth cooling

(c) Heating and cooling

(i) **Balancing temperature fluctuations**

- Building elements

(ii) **Heat sources and sinks**

- Roof ponds
- Roof radiation trap
- Vary therm wall

2.2 Definition of the problem

India possess a large variety of climates, ranging from extremely hot desert regions to high altitude locations with severe cold conditions On the basis of the monthly mean data recorded at 233 stations, located in all parts of the country, it was found convenient to divide the country into the six climatic zones as shown in Figure 1 Figure 2 shows six locations which can be considered typical of each climatic zone [3] For more than 75% of the total area of the country, summer cooling is essential to provide comfort conditions In coastal areas of the country, usually called as hot-humid regions, ventilation or air-conditioning is the common way of achieving thermal comfort in the buildings. In interior parts of the country, where hot-dry conditions prevail, desert coolers are commonly used which operates on the principle of evaporative cooling In cold climates space heating stoves (Bukhari) or radiant and convective electric heaters are used to keep the room warm All these methods of thermal conditioning of buildings consume large quantities of electrical energy or fuel wood/coal This is the problem where economically feasible solutions are yet to be found.

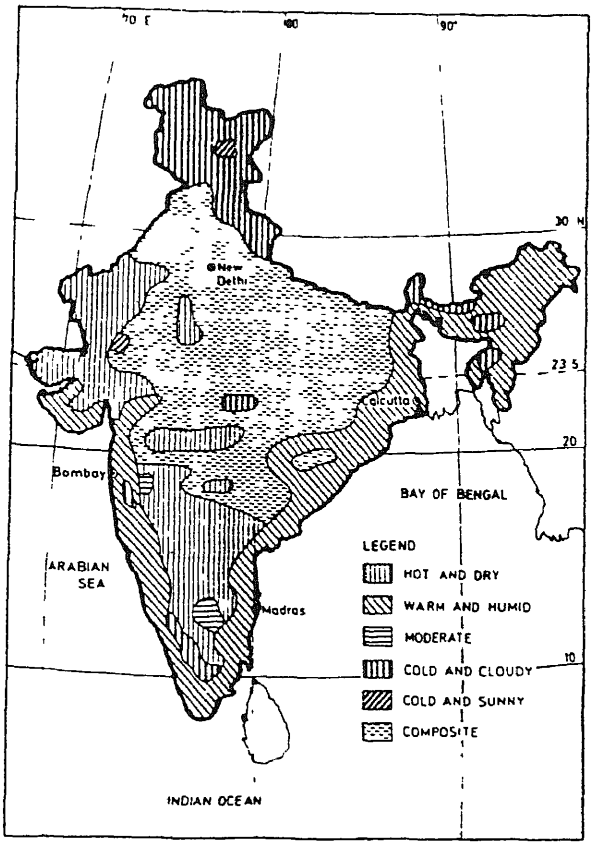


Figure 1 Climatic zones of India

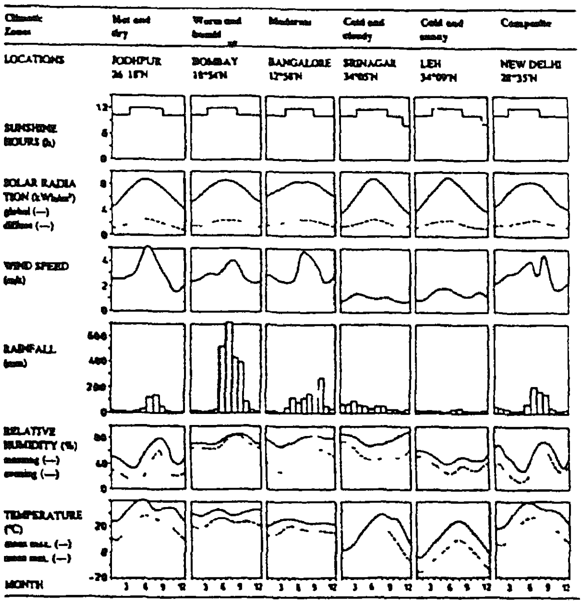


Figure 2 Details of the representative station for different climatic zones of India

Relatively large areas of central and northern India experiences composite climate which includes hot-dry, hot-humid, and cold climatic conditions. As shown in Figure 2, this region is represented by New Delhi located at 28°35'N. Passive systems, useful for such climates are those which, with little change in it, can be used both for heating in winters as well as for cooling in summers.

In order to find effective solutions for the problem of comfort conditioning in composite climates, proposal was submitted to MNES to develop a novel system of thermal conditioning of the building utilizing solar energy [1]. An integrated system utilizing solar double chimney concept was proposed in this proposal. MNES accepted this project proposal and sanctioned an amount of Rs. 6.57 lacs in March 1990 with a project duration of 2 years. This report gives detailed description of the work carried out under this project.

3.0 System Concept

The system envisaged in this project is 100% passive and does not depend on any conventional source of energy making it viable in areas where supply of conventional energy is not available or is not reliable The system is intended to provide thermal comfort conditions inside the room throughout the year by providing cooled air during hot-dry periods, creating ventilation during hot-humid seasons and supplying warm air during winter seasons As the system works throughout the year without any conventional source of energy its economic viability will be considerably better

3.1 System description

The proposed solar double chimney system, as described in the original project proposal [1] consists of two sets of solar chimneys, one located at the ground level (solar chimney I) and the other on the roof Solar chimney II located on the roof creates the necessary draft for providing sufficient air circulation through the room acting like an exhaust fan, which sucks the air from the room and throws it outside Solar chimney I located at the ground level does the conditioning of the air supplied to the room It supplies heated air to the room in winter and provides evaporative cooling in summer. Different components of the system are shown in Figures 3, 4 and 5 for summer and winter operation respectively.

3.2 Summer operation

A schematic diagram of the system showing different components used for air cooling during the summer operation is shown in Figure 3. It consists of two sets of solar chimneys, an evaporative cooling system and the necessary ducting work The cooling system used for reducing the temperature of the ambient air to room inside design temperature is shown in Figure 4 It consists of a solar chimney, a cooling tray filled with water and passages for air flow above the water surface and below the tray An air flow in the gap above the water surface is created by means of the solar chimney at the ground level The air flow over the water enhances evaporation of water and brings down the temperature of water in the tray The ambient air is drawn inside the building through the gap provided below the water tray which acts as a chiller. The draft of the air flow supplied to the building is created by the solar chimney located on the roof as shown in Figure 3 The solar chimney of the cooling system can be sized so as to create an air flow which will evaporate sufficient quantity of water from the water tray so that the temperature of the air supplied to the room is brought down to a specified design room temperature. Baffles are provided in the gap above water tray in order to increase the turbulence. Similarly fins are provided on bottom side of the tray to improve heat transfer between cold tray and air supplied to the room.

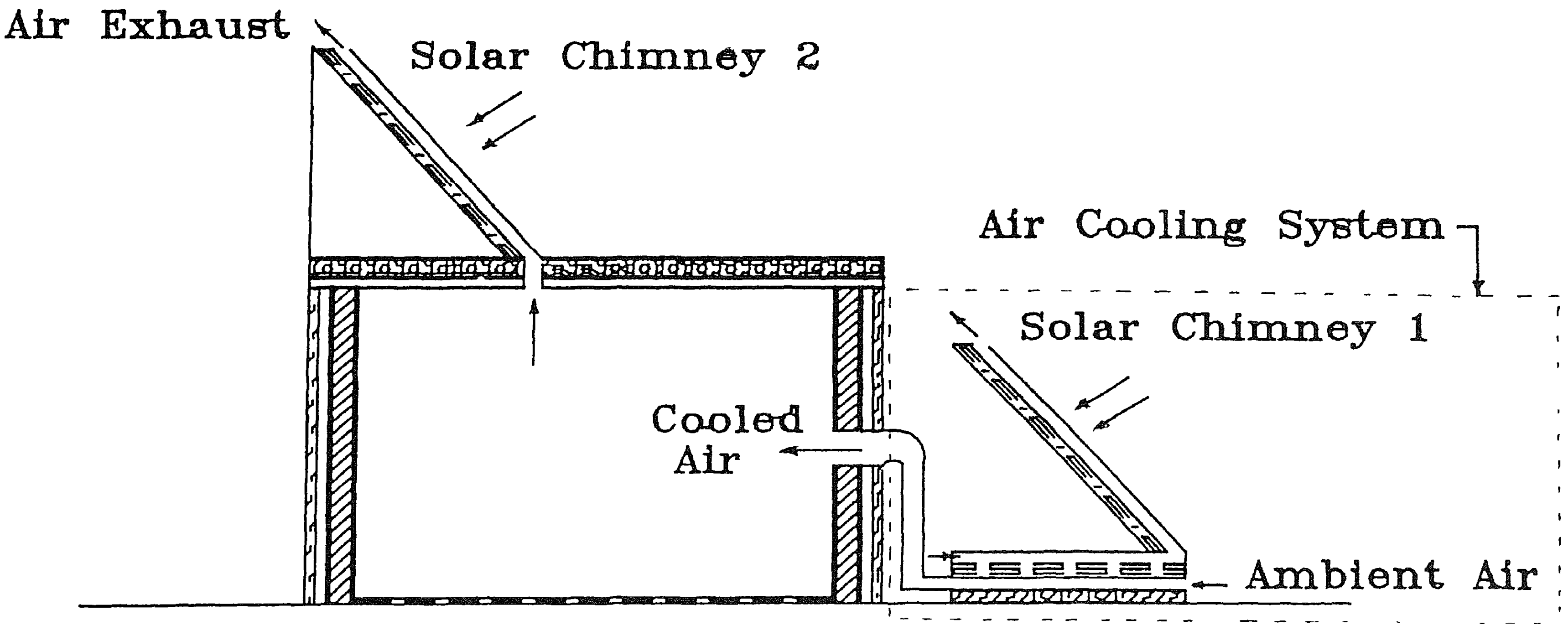


Figure 3 Schematic diagram showing system in summer operation

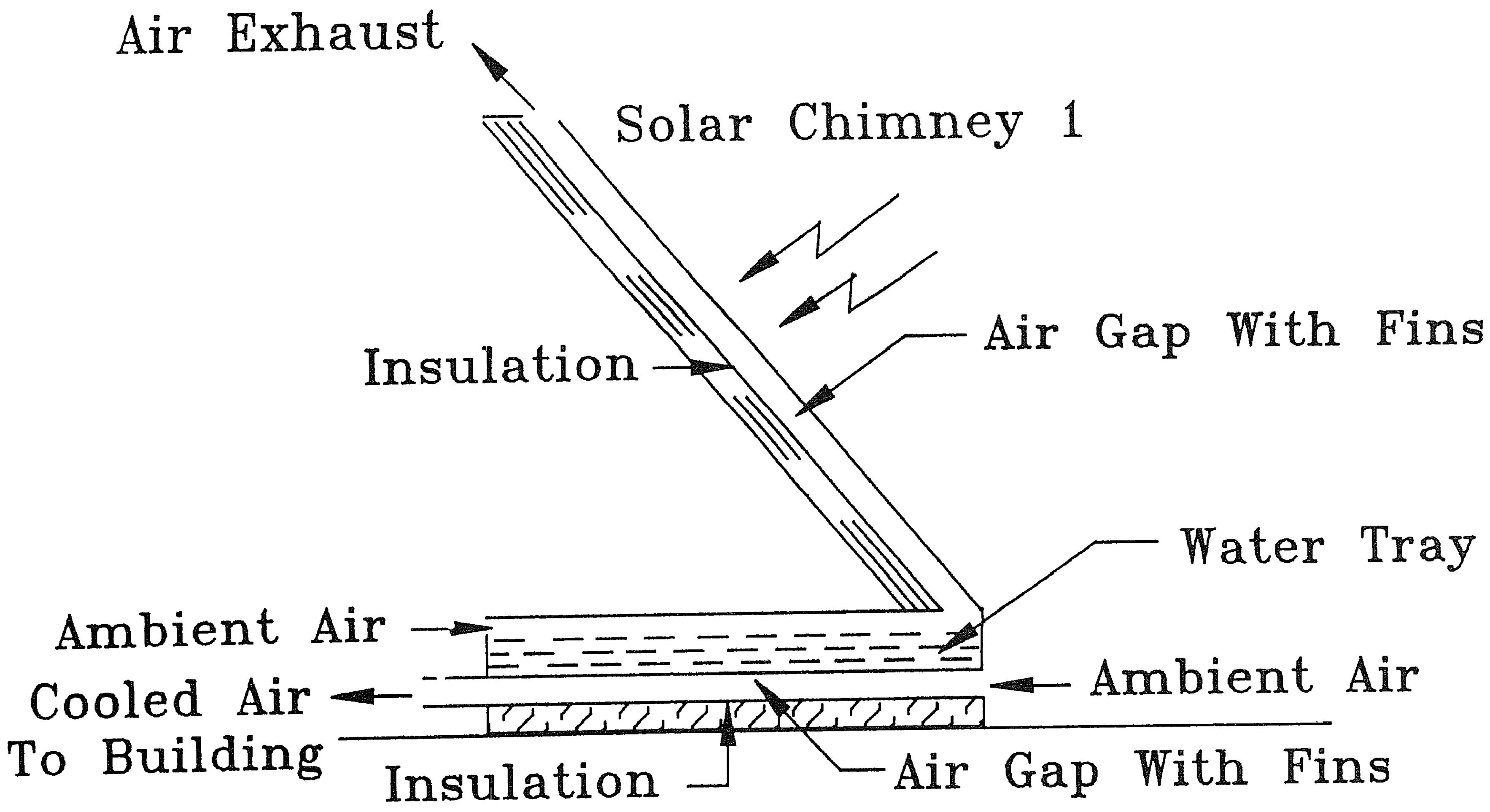


Figure 4 Schematic diagram of air cooling system

3.3 Winter operation

In winter the water in the cooler tray of the system will be drained out. The solar chimney on the ground will now be used as an air heater. The hot air coming out of the chimney will be supplied to the room. The flow of air to the inlet duct of the building will be from the top of the solar chimney instead of from the bottom of the tray as shown in Figure 5. The solar chimney on the roof functions as before to create a draft. Since the ambient temperature is lower in winter, the draft produced will be higher. Also, the series arrangement of both the chimneys in winter will increase the net draft produced.

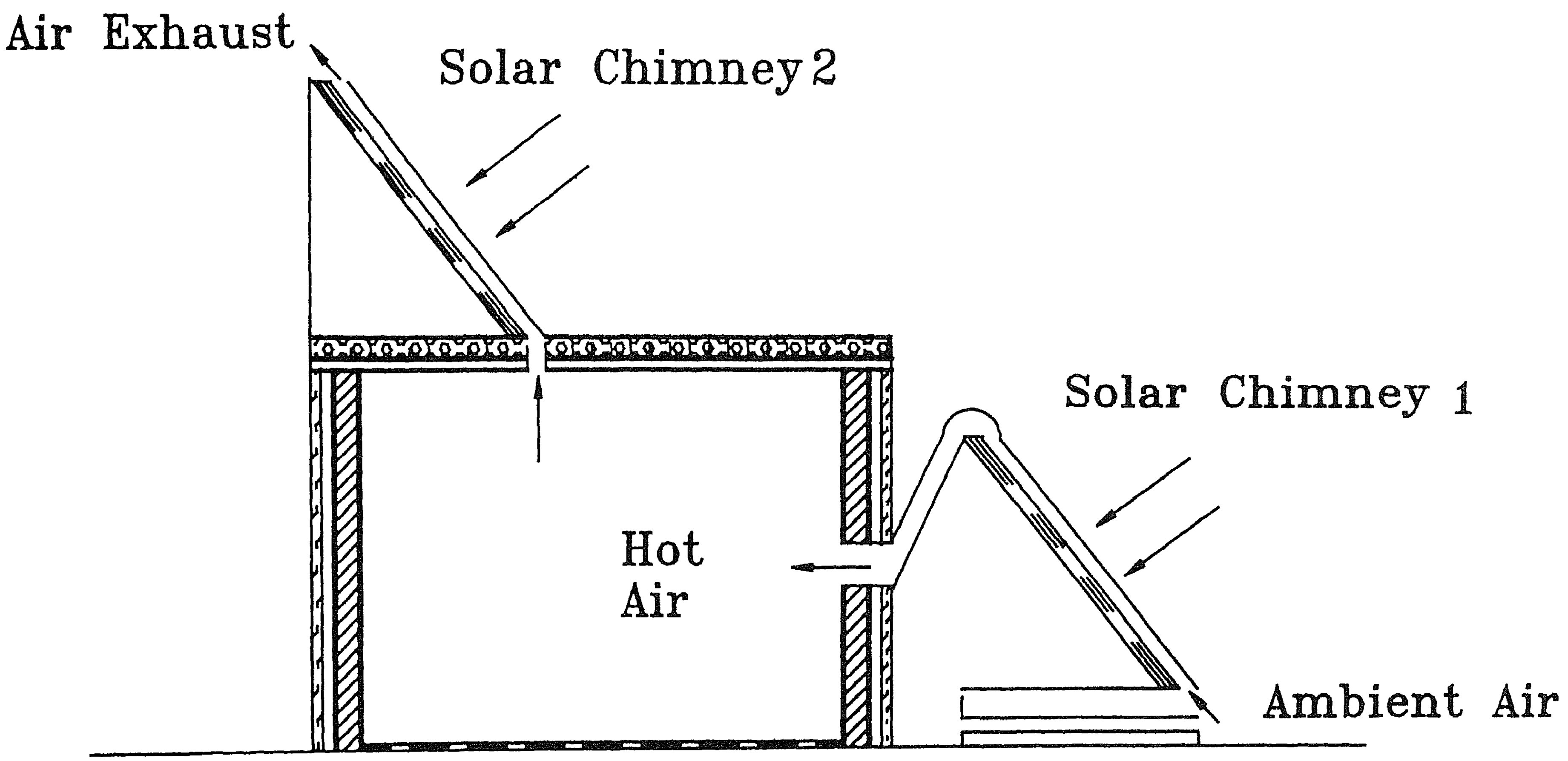


Figure 5 Schematic diagram showing system in winter operation

4.0 Modelling of Solar Chimney

Since the heart of the proposed thermal conditioning system is solar chimney, it is essential to develop a model of a solar chimney so as to study the effect of different design and operating parameters on its functioning A solar chimney is nothing but a solar air heater operating on natural convection mode The available literature on solar air heaters is mainly concerned with forced flow of air through solar collectors As solar chimney operates on natural convection mode all the parameters such as mass flow rate, rise in air temperature, pressure drop, etc are interdependent and it becomes very difficult to predict its performance For this purpose a computer model of the solar chimney was developed to predict the air mass flow rate it can handle under a given set of operating conditions, such as solar radiation intensity, ambient temperature, collector tilt angle, etc., which can help in evaluating its performance

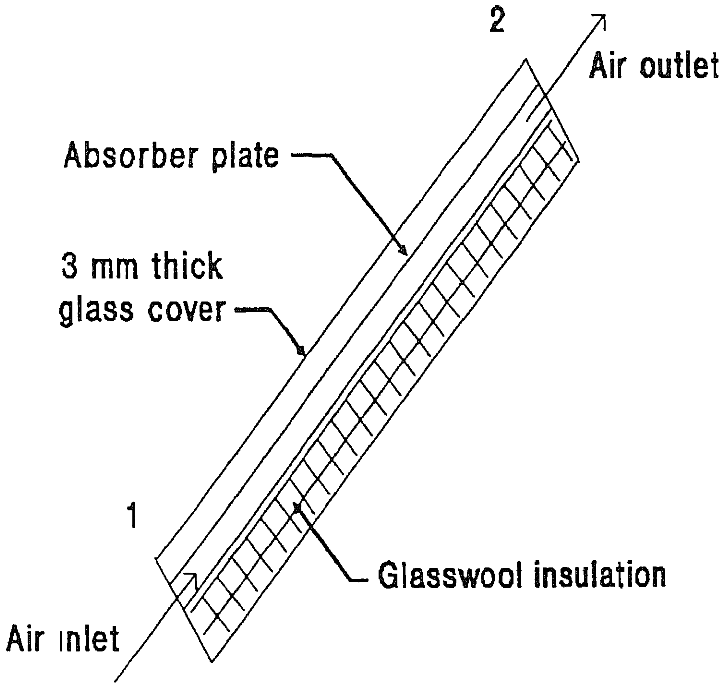
4.1 Operating principle

Solar radiation intercepted by the collector is absorbed by the absorber plate The surface of the absorber becomes hot which increases the temperature of the fresh air coming in contact with it constantly, as air moves from inlet to outlet of collector This increase in air temperature ΔT, creates density difference between inlet and outlet of solar chimney which provides the necessary driving force for air movement The air flow inside the solar chimney is strongly affected by frictional forces within the solar chimney, as well as extraneous components such as ducts, baffles etc

4.2 Analysis of solar chimney

The schematic of solar chimney considered for analysis is shown in Figure 6 The collector is 1 2 m in width and 2 5 m in length, having an aluminium absorber plate and a 3 mm thick glass sheet as glazing material at a distance of 50 mm Glasswool insulation is provided at bottom and sides The south facing, open loop system, with a tilt of 45^0 from horizontal, has air flowing below absorber plate through a gap of 50 mm between absorber plate and bottom insulation The above configuration has been selected for simplicity sake, but the model developed here can be extended to any other collector configuration and geometry

In predicting the performance of a solar chimney, it is important to determine the amount of air flow rate it can handle under particular design and operating conditions The driving force which controls the air flow rate through solar chimney is the density difference of air at inlet and outlet of the solar chimney created due to height and temperature difference and is a complex function of design and operating parameters such as solar radiation intensity, geometry, orientation, ambient temperature etc.. The higher the temperature difference, the higher is the draft created, causing more amount of air flow through collector, which has a



Length of collector = 2.5 m
Width of collector = 1.2 m
Air flow gap = 50 mm
Inclination angle = 45^0
Cover-absorber gap = 50 mm

Figure 6 Solar chimney details

tendency to lower air outlet temperature and results in higher frictional losses resulting in reduced net draft across the chimney Thus the balance of both forces controls the air mass flow rate handled by solar chimney

Applying the law of conservation of momentum to solar chimney one gets

$$\frac{\rho_1 V_1^2}{2} + (\rho_1 - \rho_2) g\, L_c \sin\beta = \frac{\rho_2 V_2^2}{2} + \frac{f_{avg}^2 2 L_c \rho_{avg} V_{avg}^2}{D_H} + \frac{K_1 \rho_1 V_1^2}{2} + \frac{K_2 \rho_2 V_2^2}{2} \quad (1)$$

Applying continuity equation at inlet and outlet of collector

$$m_{air} = \rho_1 A_1 V_1 = \rho_2 A_2 V_2 = \rho_{avg} A_f V_{avg} \quad (2)$$

If the flow area of the collector is kept constant throughout, equation (2) reduces to

$$\frac{m_{air}}{A_f} = \rho_1 V_1 = \rho_2 V_2 = \rho_{avg} V_{avg} \quad (3)$$

Considering air as an ideal gas, the density of air at any given temperature and pressure can be calculated using ideal gas equation

$$P_{air} = \frac{\rho_{air}\, R\, T_{air}}{M_{air}} \quad (4)$$

Substituting equations (2), (3) and (4) in equation (1) and after rearranging the terms one gets

$$m_{air}^2 = \frac{2\, g\, P_{atm}^2\, M_{air}^2\, (T_2 - T_1) L_C \sin\beta\, A_f^2}{R^2\, T_1\, T_2 \left[\frac{f_{avg}\, 4\, L_c\, T_{avg}}{D_H} + T_1(K_1 - 1) + T_2(K_2 + 1)\right]} \quad (5)$$

Here P_{atm} is the local atmospheric pressure which is assumed constant at various locations in the collector. The hydraulic diameter D_H is defined as

D_H = 4 x flow area/perimeter of cross section

Friction factor f_{avg} can be calculated from the well known Blasius equation which is valid for smooth surfaces [4]

f = $22/Re$ (Laminar flow)
f = $0\ 079\ Re^{0\ 25}$ (Turbulent flow)

An energy balance across the collector yields

$$m_{air}\ C_{pair}\ (T_2 - T_1) = \eta_c\ A_c\ I \tag{6}$$

Where η_c is the collector efficiency and I is the solar radiation intensity in the plane of collector Therefore,

$$T_2 - T_1 = \frac{\eta_c\ A_c\ I}{m_{air}\ C_{p_{air}}} \tag{7}$$

Substituting equation (7) in equation (5) we get,

$$m_{air}^{3} = \frac{2\ g\ P_{atm}^{2}\ M_{air}^{2}\ A_f^{2}\ L_c\ \sin\beta\ \eta_c\ A_c\ I}{C_{pair}\ R^2\ T_1\ T_2 \left[\frac{f_{avg}\ 4\ L_c\ T_{avg}}{D_H} + T_1(K_1 - 1) + T_2(K_2 + 1)\right]} \tag{8}$$

Equation (8) gives the air flow rate that can be handled by solar chimney operating with an collector efficiency η_c and raising the temperature of air from T_1 to T_2

Collector efficiency η_c can be calculated from [5]

$$\eta_c = F' \left[(\tau\alpha)_c - \frac{U_L\ (T_{avg} - T_a)}{I}\right] \tag{9}$$

Where

F' = Collector efficiency factor
U_L = Collector overall heat loss coefficient
= $U_{top} + U_{bottom} + U_{side}$

From the average mean plate temperature the top loss coefficient can be calculated by the equations developed by Klein [6] for a given configuration of solar collector Collector efficiency factor can be calculated by standard methods [7,8] In order to calculate F' and outlet air temperature T_2, an iterative method is used First an initial guess of m_{air} and T_2 is made to evaluate F' and air properties Then from equation (8) and (9) the air flow rate handled by solar chimney and the efficiency at which it is operating is calculated Then using equation (7) the new value of T_2 is calculated The procedure is continued till the assumed and calculated values of T_2 and m_{air} match

The mass flow rate handled by the solar chimney as a function of solar radiation intensity is given in Figure 7 for different ambient temperatures The corresponding operating efficiency of the solar chimney is shown in Figure 8 These figures can be used for sizing solar chimneys for different applications

As seen from Figure 7, for a given collector and given ambient conditions, the air flow rate handled by solar chimney increases with increase in input energy (i e solar radiation) and the efficiency increases with increasing radiation input For a particular input solar radiation intensity, the chimney handles higher amounts of air, (in mass terms), at lower inlet air temperatures which can be attributed to higher driving force due to higher density difference in inlet and outlet of chimney The chimney, however, operates with lower efficiency

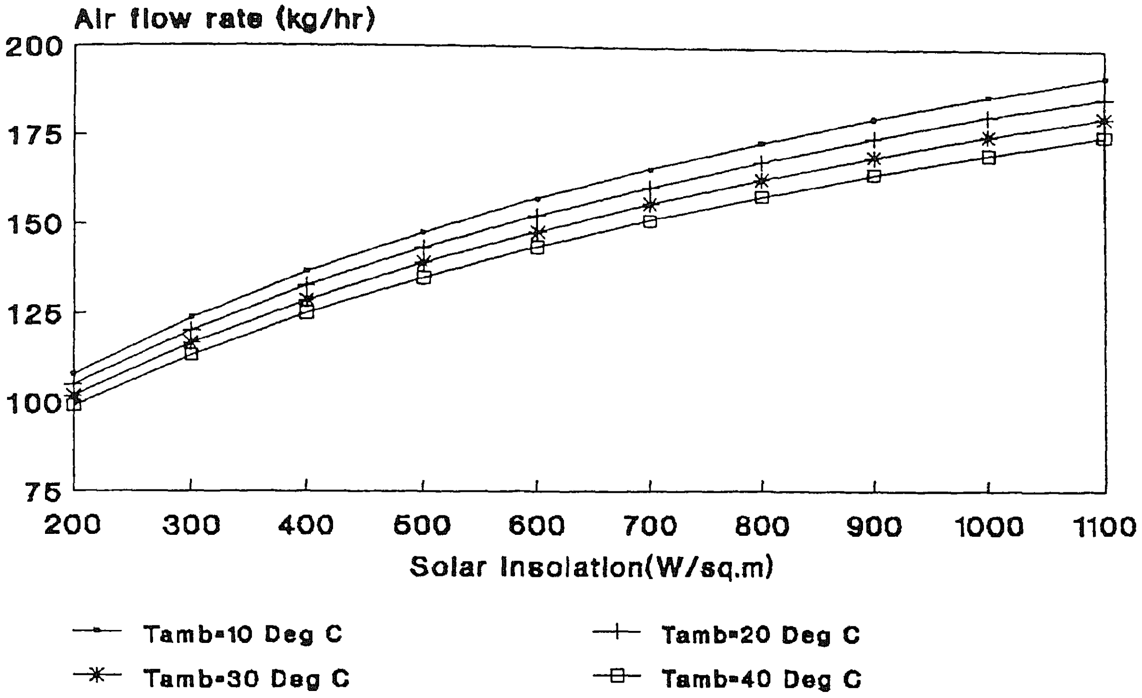


Figure 7 Variation of air flow rate handled by solar chimney with solar radiation intensity for different ambient temperatures

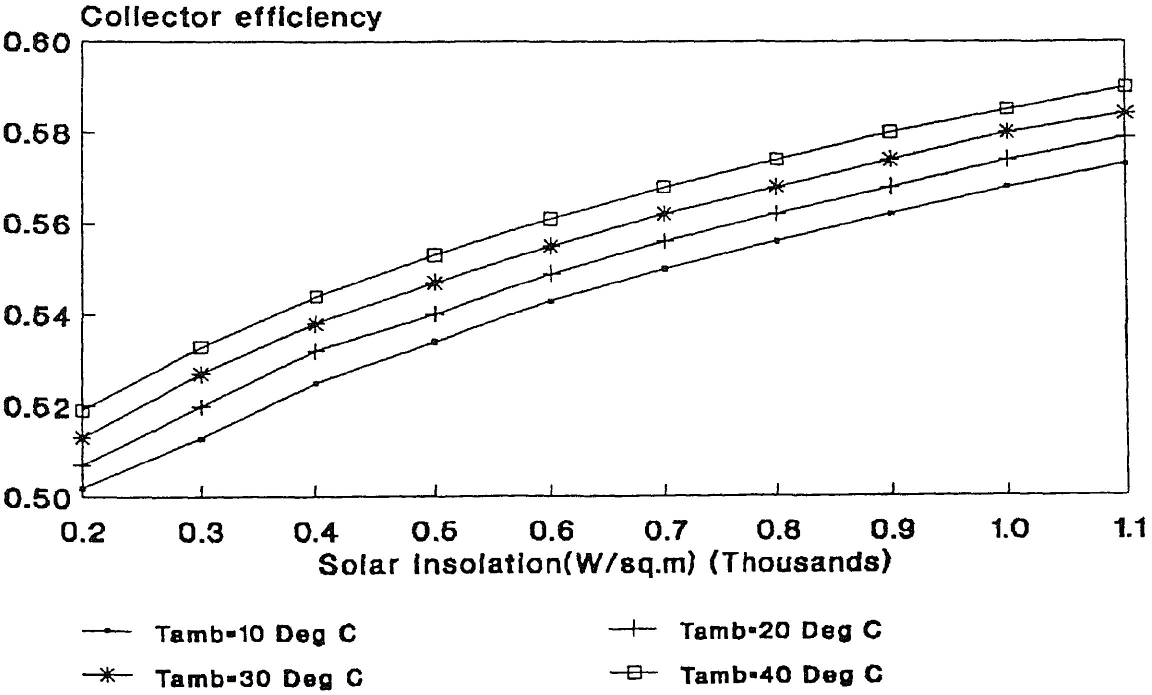


Figure 8 Efficiency of solar chimney vs solar radiation intensity for different ambient conditions

5.0 Modelling of Room Air Cooler using Solar Energy

The analysis of solar chimney, given in the previous sections, is extended here to model air cooling component of the proposed system in order to size the water tray area required to reduce the temperature of the ambient air to room temperature The operating principle of the air cooling system (shown in Figure 4) is explained in detail in the previous section describing summer operation of the proposed system In the following paragraphs details of the computer programme, developed primarily to calculate the water tray area required to provide chilling effect on the air let into the room are given The governing parameters to be fed for computer simulation are.

(i) Geometrical parameters width and depth of ducts carrying air into the room, inlet-outlet ports, geometrical details of the top chimney, etc
(ii) Operation parameters. ambient conditions (temperature, humidity, wind velocity etc.), room temperature, solar insolation level, etc

As the air flows through the passage over the surface of water tray, due to draft created by bottom solar chimney, it comes into direct contact with the water Due to difference in vapour pressure, air absorbs moisture resulting in steady increase of humidity, and decrease in its temperature as air flows from inlet to outlet In order to take into account the temperature and humidity gradient along the air passage (both above and below the water tray) in the air cooling system, it is divided into several segments, (10 in the present case) For each segment the outlet condition of air (which will be inlet condition for next segment) is found by calculating the increase in humidity due to water evaporation in the tray and heat transfer between air and water For this purpose, initially the room temperature is assumed equal to the design condition to estimate initial mass flow rate handled by top solar chimney From the evaporative cooling effect on cooling water and total heat removal rate, the room temperature achievable is calculated for initially assumed tray size and the calculation is repeated to get the tray area till the calculated minimum achievable room temperature is reached Figure 9 gives the computational procedure in the form of a flow chart

The design procedure can be divided into following steps

(i) Calculation of air flow rate handled by top and bottom solar chimneys
(ii) Calculation of wet bulb temperature and hence water film temperature
(iii) Calculation of heat transfer rate in water tray
(iv) Calculation of heat transfer coefficient in air passage
(v) Calculation of evaporative cooling effect, total heat removal rate and hence the area of tray required

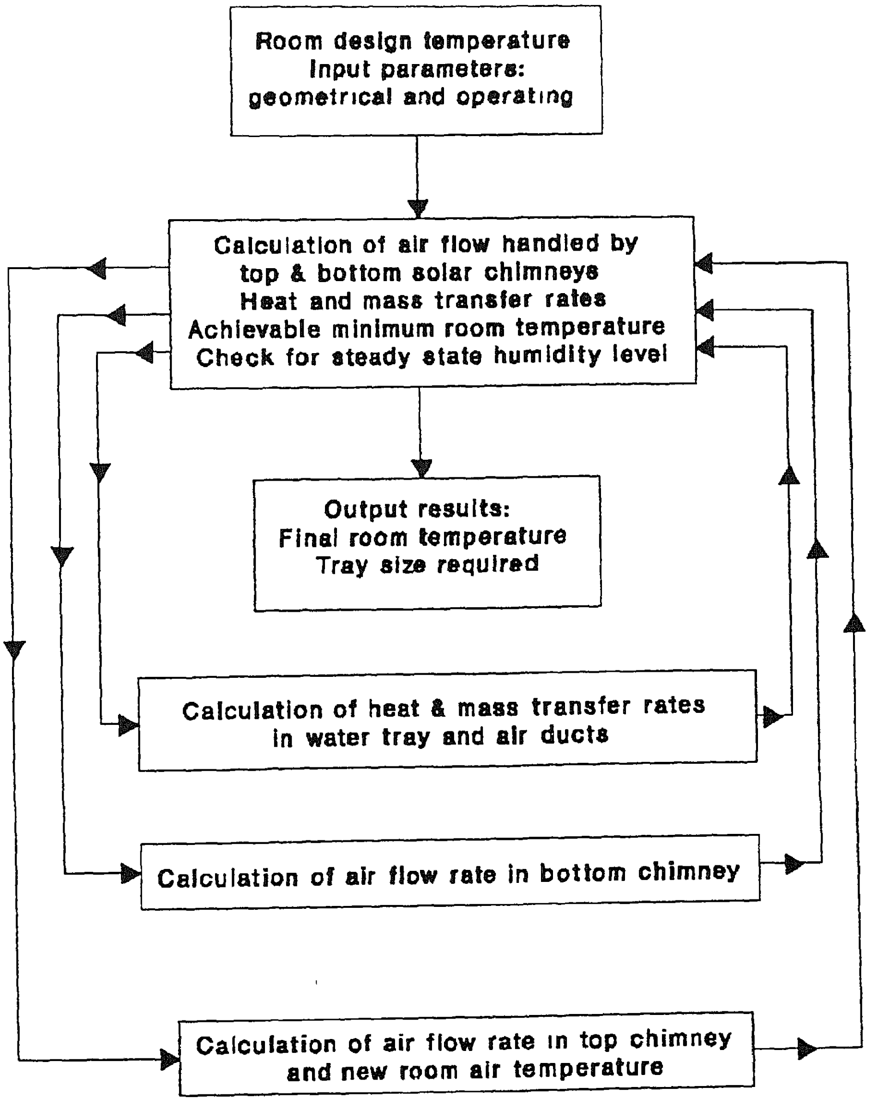

Room design temperature
Input parameters:
geometrical and operating
Calculation of air flow handled by
top & bottom solar chimneys
Heat and mass transfer rates
Achievable minimum room temperature
Check for steady state humidity level
Output results:
Final room temperature
Tray size required
Calculation of heat & mass transfer rates
in water tray and air ducts
Calculation of air flow rate in bottom chimney
Calculation of air flow rate in top chimney
and new room air temperature

Figure 9 Flow chart for computer simulation of air cooling system

5.1 Air flow rate handled by solar chimney

Detailed procedure for estimating air flow rate handled by solar chimney under given operating conditions is given in the earlier sections It is based on applying law of conservation of momentum and energy across the chimney and using continuity and ideal gas equations

In estimating the air flow rate handled by the top solar chimney, the inlet temperature will be room temperature, which in turn depends upon effectiveness of air cooling system Also, additional frictional losses in the air duct passage in the air cooling system and at inlet and outlet ports have to be taken into account

The inlet condition of the air entering the bottom solar chimney is humid as it comes out from the outlet of the water tray The humidity level in the air depends on amount of water evaporated which again depends upon draft created by bottom chimney

5.2 Estimation of wet bulb temperature

Wet bulb temperature (wbt) on the basis of dry bulb temperature (dbt) and relative humidity (ϕ) follows nearly perfect linear relationship as given below [9].

$$t_{wbt}\ (\text{estimated}) = a(\phi) + b(\phi)\ t_{dbt} \tag{10}$$

where a(ϕ), b(ϕ) are variable functions of (ϕ) as given in Table 1

A limitation of this correlation is that it does not provide values for humidity levels below 30%. The temperature should be in degree Farhenhiet

Table 1: Functions a(ϕ) and b(ϕ) for estimating wet bulb temperature

Parameters for estimating t_{wbt}		
ϕ	b (°F/°F)	a (°F)
0 3	0 750256	-1 156450
0 4	0 811202	-2 491510
0 5	0 858568	-2 291168
0 6	0 896186	-2 262370
0 7	0 928161	-2 266730
0 8	0 955048	-1 561950
0 9	0 978813	-0 805760

5.3 Heat transfer coefficient of water in the tray

Depending upon the temperature (T_f) of the film of water Grashoff number (Gr) and thermal conductivity (k_f) values are calculated Then heat transfer coefficient h_o can be calculated from

$$GrPr = Gr\ L_c^3\ (T_a - T_f) \tag{11}$$

$$h_o = \frac{k_1}{L_c} C\ (Gr\ Pr)^M \tag{12}$$

where

L_c = Characteristic length

Constants C and M are evaluated depending upon product of Gr and Pr (whether it is less than or greater than 8×10^6)

Saturation pressure of water vapour (P_s) at ambient temperature T_a is obtained by Antoine's equation which can be written as [10]

$$\ln\left[\frac{(P_s)_{T_a}}{(P_s)_{T_{ref}}}\right] = \frac{3885}{T_{ref} + 230} - \frac{3885}{T_a + 230} \tag{13}$$

Where T_{ref} is reference temperature (100°C) and $(P_s)_{ref}$ is a reference vapour pressure (757 7 mm Hg) The above equation gives the vapour pressure in the units of mm Hg when T_a is expressed in °C

Partial pressure of water vapour (P_w) can be calculated for given relative humidity (ϕ) value as

$$\phi = \frac{P_w}{(P_s)_{T_a}} \tag{14}$$

5.4 Heat transfer coefficient in air passage

For calculation of Reynolds number (Re) the necessary parameters such as density (ρ), Prandtle number (Pr), conductivity (k_1) are calculated corresponding to the ambient conditions prevailing near the entry of the tray The heat transfer coefficient can then be calculated from

$$Nu = \frac{h_i\ D_h}{k_1} = 0\ 023\ Re^{0\ 8}\ Pr^{0\ 3} \qquad (15)$$

where

D_h = hydraulic diameter

Nu = Nusselt number

Then room temperature (T_r) attainable under perfectly ideal conditions can be calculated as

$$T_r = \frac{h_i\ T_a + h_o\ T_f}{h_o + h_i} \qquad (16)$$

If the calculated value of T_r differs from the initial assumed value, in the estimation of air flow handled by solar chimney, the above procedure is iterated until both temperatures do not differ by more than 0 01°C

5.5 Calculation of evaporative cooling and tray area

Evaporative cooling due to air draft created over water tray by bottom solar chimney is calculated as below [11]

$$Q_e = \frac{\lambda\ h_c\ (P - P_w)}{1\ 6\ C_s\ P_t} \qquad (17)$$

where

h_c = convective coefficient due to air velocity

λ = latent heat of vaporization of water

C_s = heat capacity of humid air

P_t = atmospheric pressure

After substituting proper values for λ, C_s and P_t in the above equation we get

$$Q_e = 2\ 2\ h_c\ (P - P_w) \qquad (18)$$

The cooling effect of water due to its evaporation is reduced to some extent by the heat gain by the water by convection (Q_c) and radiation (Q_r) due to temperature difference between water film and air flowing over it

$$Q_c = h_c A (T_a - T_f)$$

$$Q_r = \sigma \epsilon A (T_a^4 - T_f^4)$$

Therefore, net cooling effect (Q_{net}) due to air draft

$$Q_{net} = Q_e - Q_c - Q_r$$

This heat gain is significant in the initial portion of the duct near air inlet, and diminishes fast as the air temperature drops, and comes closer to T_f, due to rise in humidity level by absorption of moisture from water film surface

In order to take into account the rising humidity level of the air as it flows through the air passage above water tray the mass of water evaporated is calculated. If Q_e is the heat lost by evaporation and A is the area of the tray the mass of water removed from the tray due to evaporation will be

$$m_w = \frac{Q_e A}{\lambda} \tag{19}$$

The increment in the specific humidity (Δw) can be arrived as :

$$\Delta w = \frac{m_w}{m_{a,2}} \tag{20}$$

Where $m_{a,2}$ is the mass of air flowing through the duct over the water tray due to draft created by bottom solar chimney. This $m_{a,2}$ is also iterated for ambient temperature similar to the iteration done in calculating mass of air flowing into the room

To initiate an iterative process consecutive relative humidity levels are checked for a difference of 0 01 which evaluates the mean steady state humidity. For every newly calculated relative humidity level the change in film temperature is also calculated within the iterative procedure itself.

Therefore, total heat removed from the air before entering the room is given by

$$Q = m_{a,1} \; C_a (T_a - T_r) \tag{21}$$

Where,

$m_{a,1}$ = mass of air handled by top solar chimney

C_a = heat capacity of ambient air

Thus area of tray required for cooling air from ambient temperature to design room temperature will be

$$Area = \frac{Q}{Q_{net}} \qquad (22)$$

Table 2 gives sample output data giving the details of the room temperature which can be achieved for given ambient conditions, tray area required to achieve this for different ambient conditions and solar radiation intensity levels. Here the solar chimney of 2.5 m in length and 1.2 m in width is considered with 2 inch gap between glass cover and absorber plate. Surprisingly it is observed that with increase in solar radiation intensity tray area required increases. With increase in solar radiation intensity more quantity of air flow is handled by top solar chimney, which in turn increases the load on air cooling system. Therefore more water tray area is required with increase in solar radiation intensity, as quantity of heat required to be removed to cool the air supplied to the room increases by greater margin than increase in rate of evaporation cooling.

Table 2: Cooling water tray area required under different operating conditions

Solar radiation intensity (W/m^2)	Ambient Temperature (°C)	Design Room Temperature (°C)	Area (m^2)
300	30	21.5	3.403
	35	25.4	3.211
	40	29.2	3.017
	45	33.1	2.828
400	30	21.5	3.660
	35	25.4	3.456
	40	29.2	3.247
	45	33.0	3.044
500	30	21.5	3.855
	35	25.4	3.637
	40	29.2	3.416
	45	33.0	3.203
600	30	21.5	4.016
	35	25.4	3.789
	40	29.2	3.559
	45	33.1	3.336
700	30	21.5	4.156
	35	25.4	3.921
	40	29.2	3.683
	45	33.1	3.452

Ambient air relative humidity = 40%

Collector area = 3.25 m^2

6.0 Prototype System

In the original proposal, it was suggested that two identical buildings will be constructed, so that one can act as a reference building while the other building can be used for installation and performance testing of proposed solar double chimney concept for its effectiveness This would have enabled one to see accurately the level of improvement in the comfort conditions inside the building due to installation of proposed system But, MNES suggested to carry out retrofitting on the existing single room building at TERI's Gual Pahari campus, to study the viability of the proposed system Hence the project essentially was shaped into testing of proof of concept

6.1 Retro-fitting of an existing one room building

The existing single room measures 5 m in length, 4 m in width and 3 m in height, with length parallel to north-south direction The masonry brick wall is 9" thick, whereas the RCC roof slab is 4" thick, with cement plaster layer on both sides The room has one south facing door (area = 2 m^2) and two windows (area = 1 m^2 each) on east and west side walls. Standard thermal network analysis (considering each component of building and thermal resistance, analogous to electrical resistance, offered by it e g brick wall, plaster layer, window, door etc) was carried out to find out heat load of the building for design indoor and outdoor conditions. The unitary heat load, C_d (heat load per unit volume of the room), of the existing building works out to be 2.904 W/m^3K

In order to reduce the thermal load of the building, which in turn will reduce the sizing of the thermal conditioning system required for the building, the following modifications were incorporated

- Providing double glazed windows with curtains
- Providing a door with 1" thick thermocole layer and 6 mm thick plywood layer from inside.
- Providing 1" thick thermocole insulation outside walls and thin ferrocement plaster layer keeping 1" air gap in between
- Providing 1" thick thermocole insulation on inside of the roof and false ceiling of 6 mm thick plywood with 1" air gap in between.

The thermal network, showing different resistances and their series-parallel combinations for the modified building, incorporating the above mentioned modifications, is shown in Figure 10. Applying the thermal network analysis to the network of modified building, the unitary load (C_d) works out to be 0.861 W/m^3K Comparison of thermal heat for existing and modified building is given in Table 3 Thus the above mentioned modifications helps in reducing the heat load on the building by nearly 70%

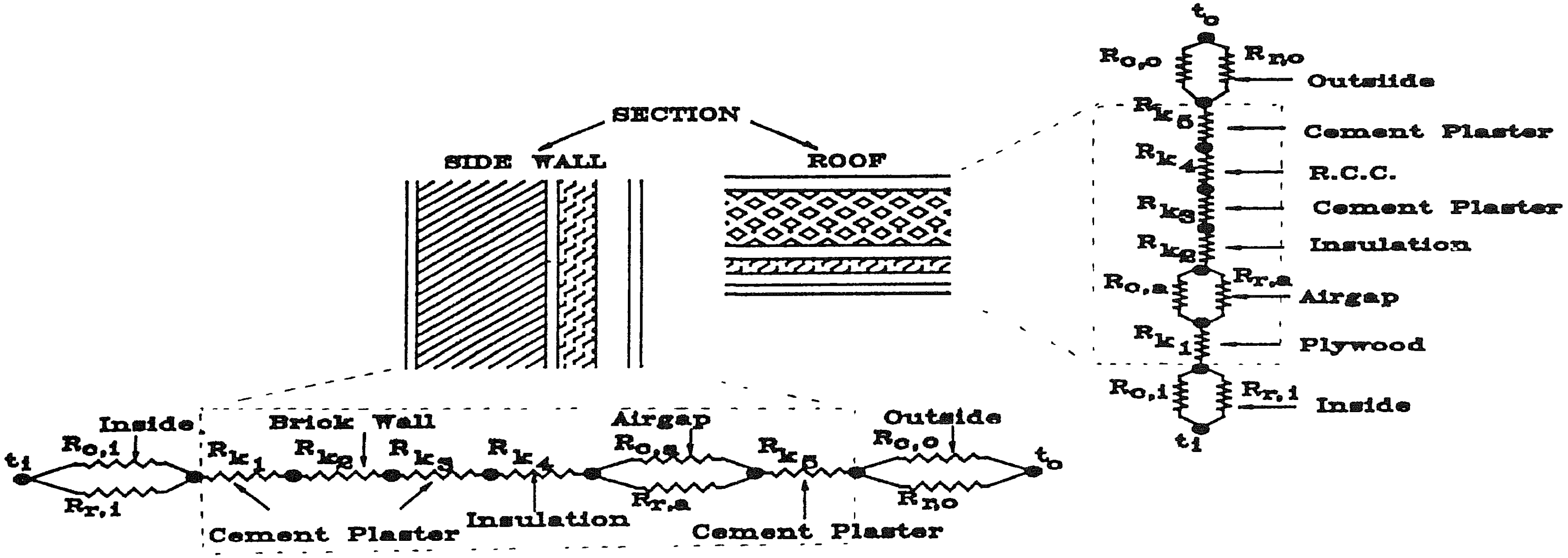


Figure 10· Thermal network of modified building

Table 3: Comparison of thermal load for existing and modified building

Building component	**Area** (m^2)	**Temperature difference** (t_o-t_i) (K)	**Unitary thermal conductance** (W/m^2 °K)		**Heat load** (Watts)	
			Building		Building	
			Existing	Modified	Existing	Modified
Floor	20	11	0 900	0 160	198 00	35.20
Roof	20	11	2 940	0 776	646 80	170 72
Walls	50	11	1 469	0 419	807.95	230 45
Windows	2	11	6 000	3.000	132 00	66 00
Door	2	11	6 000	3.000	132 00	66 00
Total thermal load (Watts)					1916 75	568 37
Unitary heat load C_d (W/m^3 °K)					2.904	0 861

6.2 Sizing of solar chimneys

From the thermal network analysis, the value of C_d is determined For given building dimensions, the total heat load is calculated after considering heat load through building structure, infiltration and occupants, etc From design inside and outside conditions the air circulation rate required through building is calculated This air flow rate has to be handled by solar chimney located on the roof of the building To bring down the temperature of the air supplied to the room from ambient temperature, the amount of water needed to be evaporated in cooling system is calculated assuming 80% efficiency of evaporating process Then amount of air flow rate above the water tray necessary to evaporate this quantity of water is calculated from the dry bulb and wet bulb temperature of ambient air. This air flow rate has to be handled by the solar chimney located on the ground

The area of the solar chimney required to create the necessary draft and to provide the required air flow rate is calculated using the model described in the previous sections The amount of air flow rate required and size of the corresponding solar chimney is tabulated in Table 4

Thus, in order to carry out thermal conditioning of the room, set of solar chimneys, consisting of three collectors (of size 1 2 m x 2.5 m each) at the top and two collectors at the bottom level are required for summer and winter operation. As can be seen, the area requirement for performing summer operation is almost double than that required for winter operation Also, circulation rate (draft) required through room and through air cooling/heating component is comparable and it may be possible to use the draft of top chimney for cooling purpose too, thus doing away with bottom chimney, which means reduction in system cost

Table 4: Sizing of solar chimneys

Parameter	Summer operation	Winter operation
Design ambient conditions (°C)	DBT = 38 0 WBT = 24 3	DBT = 15 0
Design room temperature (°C)	27	27
Heat load (Watt)	1200	1000
Air circulation required through room (kg/hr)	391	255
Area of top solar chimney (m^2)	6 44	3 97
Air circulation required through solar chimney of cooling/heating system (kg/hr)	398	255
Area of solar chimney of cooling/heating system (m^2)	6 74	4 08

7.0 Fabrication and Installation of the System

After developing the computer model for sizing solar chimney and cooling water tray, thermal network analysis of building modification to reduce heat load giving preliminary design of the system, fabrication of individual system components, viz. solar chimneys, air cooling/heating system, building modifications, was undertaken Details of fabrication of each system component and its installation is described in this chapter along with illustrative pictorial views

7.1 Solar chimneys

Solar chimneys of size 2.5 m length and 1 2 m width were fabricated Absorber plate is coated with black paint, and covered with glass keeping a 2" air gap for air flow above the absorber plate. Initially, ordinary blackboard paint was used, which was later on replaced with high temperature resistant paint This lasts long and does not peel out due to high absorber temperatures attained in the solar chimney Louvers, inclined at an angle of 45° to absorber plate, are provided in the air gap to create turbulence in air so as to improve the effectiveness in heat transfer. Arrangement is made to change the inclination of the louvers, if required The close-up of solar chimney is shown in Figure 11 Solar chimneys are insulated with 2" thick glass wool layer on bottom side of absorber plate. The side frame of the collector is fabricated with aluminium channels Rubber beading is provided while fixing the glass to prevent heat loss through any leakage of hot air.

Though the solar chimney area required worked out to be more than 6 m^2 (equivalent to three chimneys of size 1 2 m x 2 5 m each), it was decided to go ahead with two solar chimneys This was done because the width of the building in east-west direction is 4 m, and after installing three collectors, very little working space would have been available This would result in inadequate summer performance but still would give an idea of the effectiveness of the proposed solar chimney, which is the primary objective of the project Therefore, two set of solar chimneys were installed on the roof facing south and making 30° angle with the horizontal At the chimney outlet, an umbrella type cover was provided so that hot air can escape without any resistance, but wind will not enter the collector in the reverse direction adversely affecting the chimney draft This also prevented rain water from entering through chimney outlet and accumulating in the duct connecting solar chimney to room In order to keep the solar chimneys in position an MS angle frame (stand) was fabricated

Two rectangular holes were made in the roof (see Figure 12) in order to connect the room to the solar chimney bottom inlet through GI ducts Close-up of the duct arrangement, connecting the solar chimney to room, is shown in Figure 13 All the joints in the ducting were sealed to prevent leakage of air by pasting cotton strips with fevicol At the bottom end

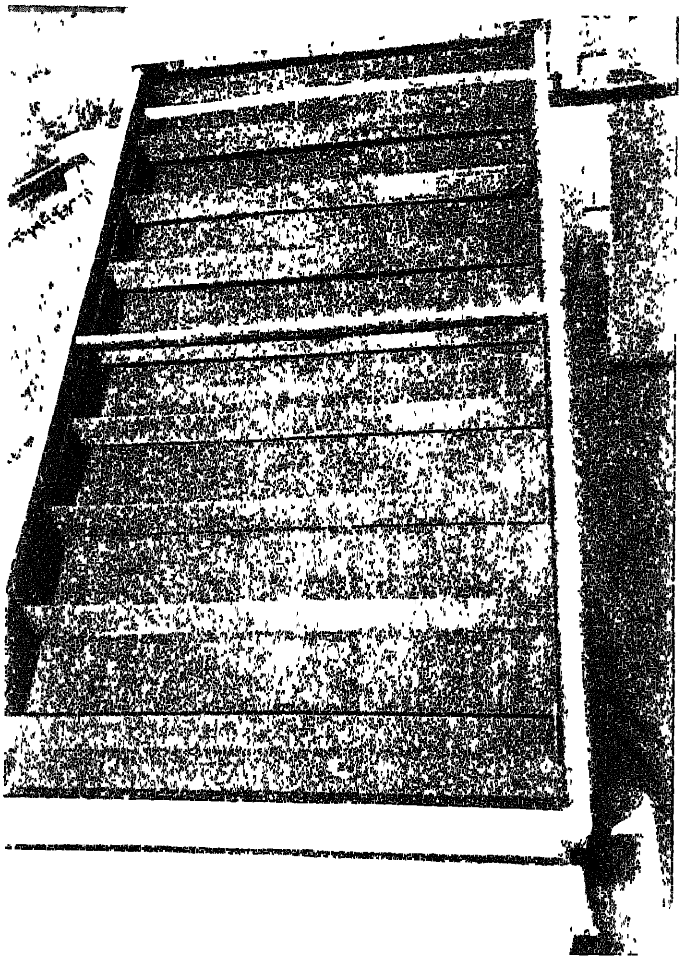


Figure 11 Solar chimney with louvers provided in air passage

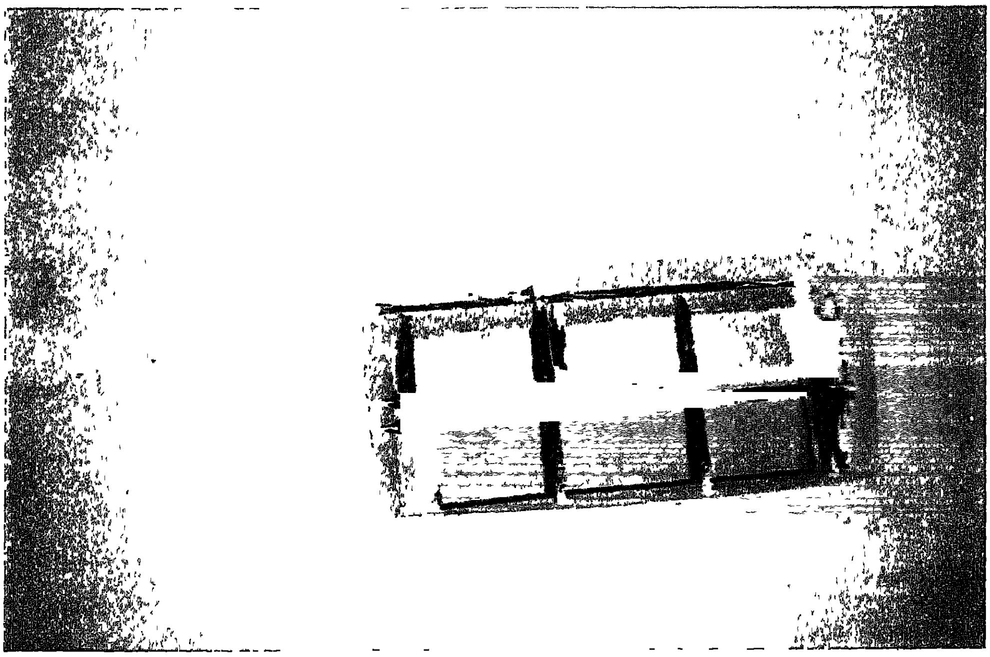


Figure 12 Rectangular air holes provided in the roof to connect room to solar chimney

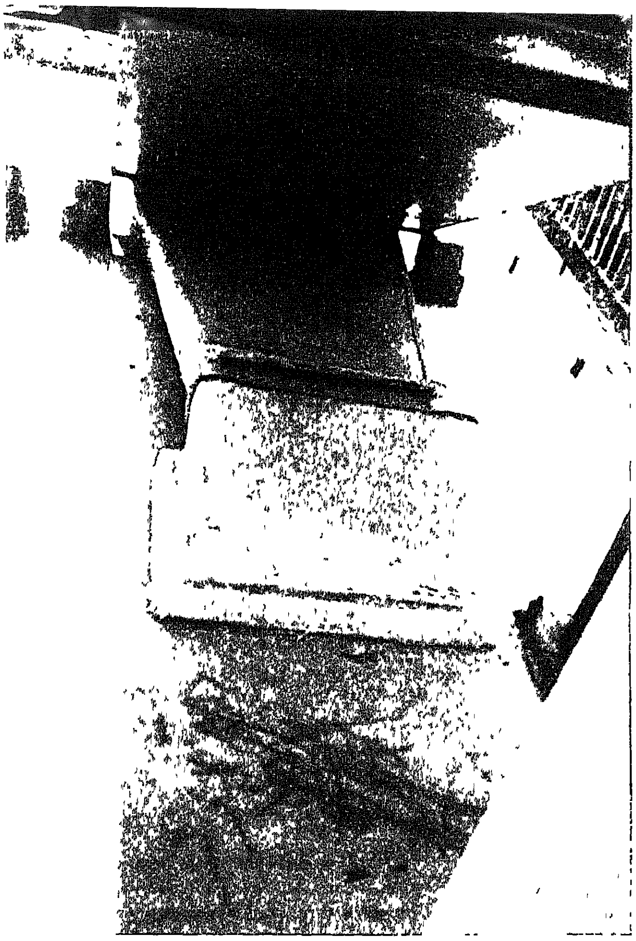


Figure 13 Close up of duct arrangement connecting solar chimney to room

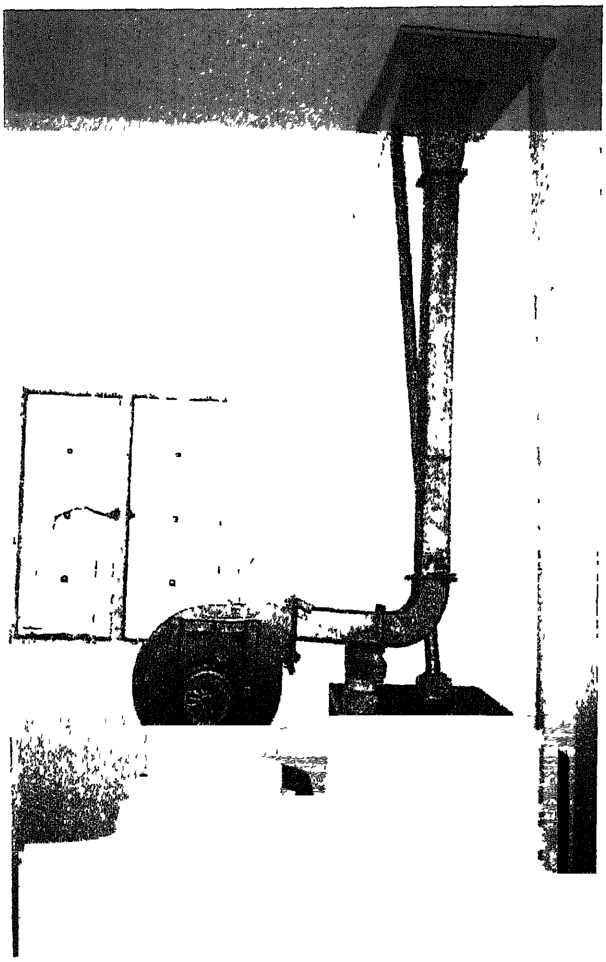


Figure 14 Set up of blower for leak testing of solar chimney and associated ducting

corner of the glass cover the rectangular corner was filled with putty so that no water can accumulate there and seep inside The complete ducting work was tested for leakages For this purpose, a 1 HP blower was connected to the air ports provided in the roof, from inside, with the help of GI duct and outlet of chimney was closed with the help of rubber gasket, plywood and clamps Figure 14 shows the arrangement of blower made to carry out leakage test After the blower was switched on, the duct and collector get pressurized with air Leakage was tested by applying soap solution on all joints

7.2 Air cooling system (for summer operation)

In the originally proposed system concept (Figure 3, 4), one set of solar chimney was suggested to create air draft over the cooling water tray to evaporate water which in turn will indirectly cool the air (sensible cooling) going into the room through an air duct below the water tray Also, as described in the earlier section, the air circulation rate required through room and through air cooling system are comparable and it may, therefore, be possible avoid installation of set of solar chimneys located at ground level As this combination can result in significant reduction in system cost, without affecting the performance much, it was decided to go for direct evaporative cooling of air In this configuration, the air circulation created by the top solar chimney is passed over the water trays before entering the room This will have direct contact of air with the surface of water in the tray. For this purpose, 4' x 8' trays were fabricated with 2" depth, so as to accommodate sufficient quantity of water It was covered with plywood plank, keeping a 2" air gap carrying ambient air into the room Figure 15 shows details of the cooling water tray arrangement. In the south side wall of the room, two air inlet ports were made at the lower level (see Figure 16) to connect the duct carrying cooled air into the room These duct was insulated with 2" thick glass wool to prevent heat addition to the conditioned air before entering into the room. Figure 17 shows complete view of the system in summer operation

7.2.1 Further modifications in air cooling system

After monitoring of the system during the summer of 1992, it was observed that it works satisfactorily during hot-dry summer season. As the air cooling system is based on direct evaporative cooling principle, the cooling effect diminishes with increase in humidity of the ambient air, necessitating further system modifications In order to overcome this drawback, it was decided to carry the air going to the room through a rectangular duct immersed inside the water in the cooling water tray. The plywood cover is placed over the water surface in the tray so as to permit evaporation of water but prevent solar radiation to be absorbed The immersed air duct provides sensible cooling and enhanced (top and bottom side) area of contact for heat transfer from cold water to air, thereby improving heat transfer and avoiding increase in humidity levels inside the room. The modified configuration of the system for summer operation is shown schematically in Figure 18.

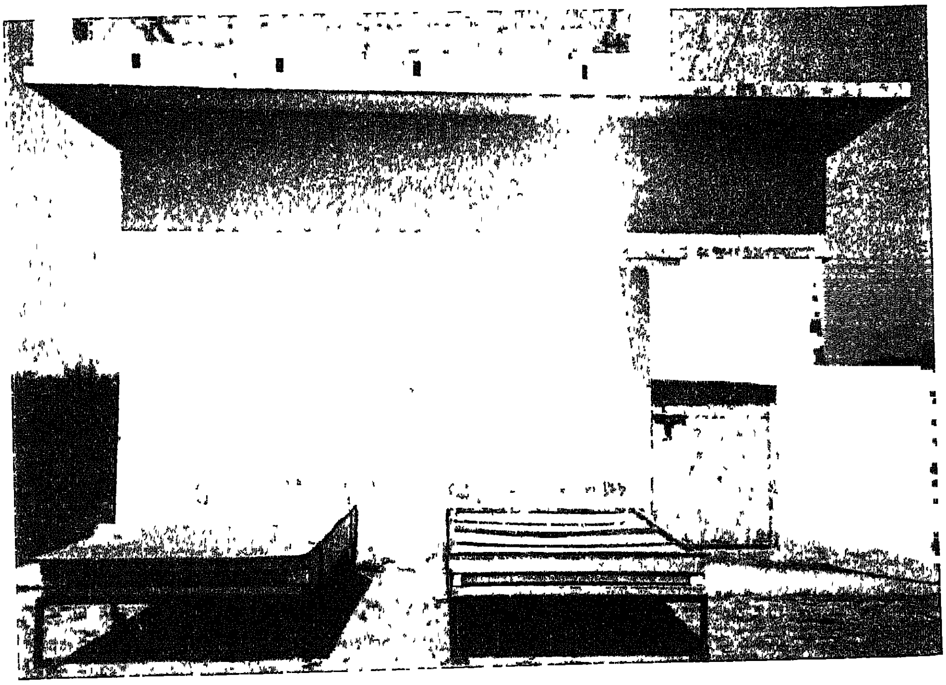


Figure 15 Cooling water trays installed for air cooling

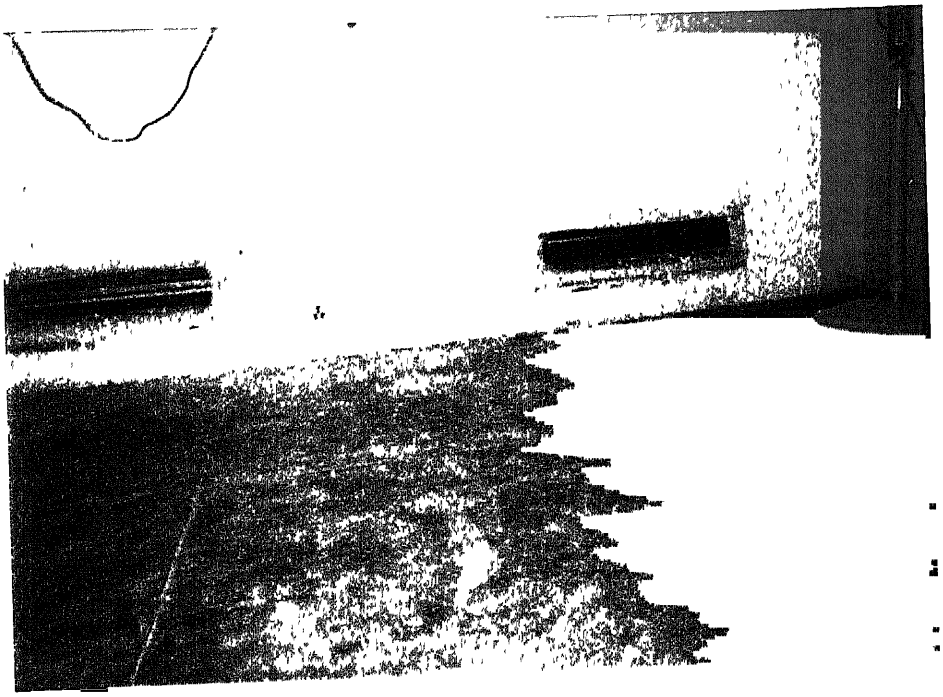


Figure 16 Air inlet provided in the wall which brings cooled/heated air into the room

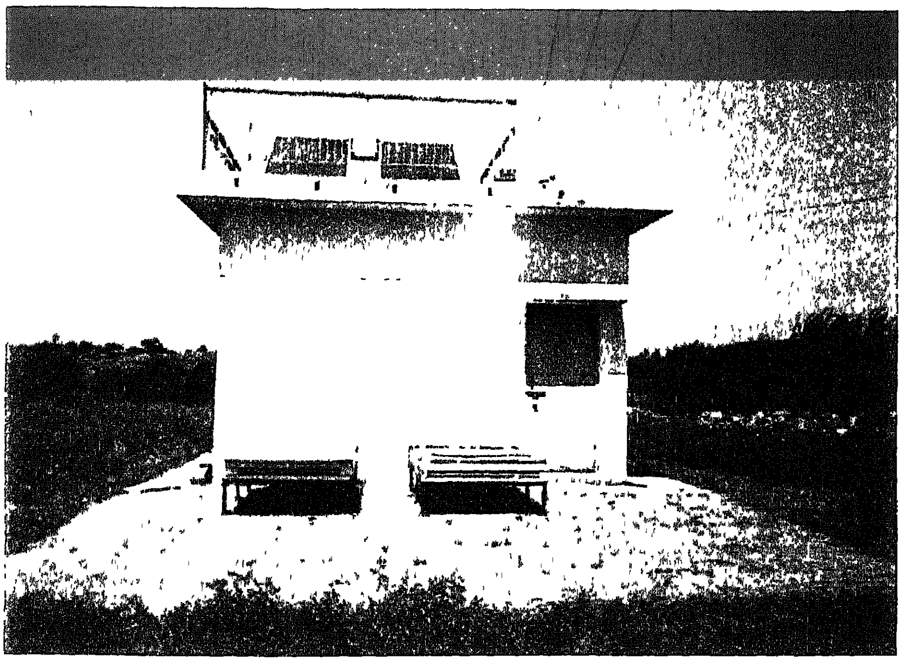
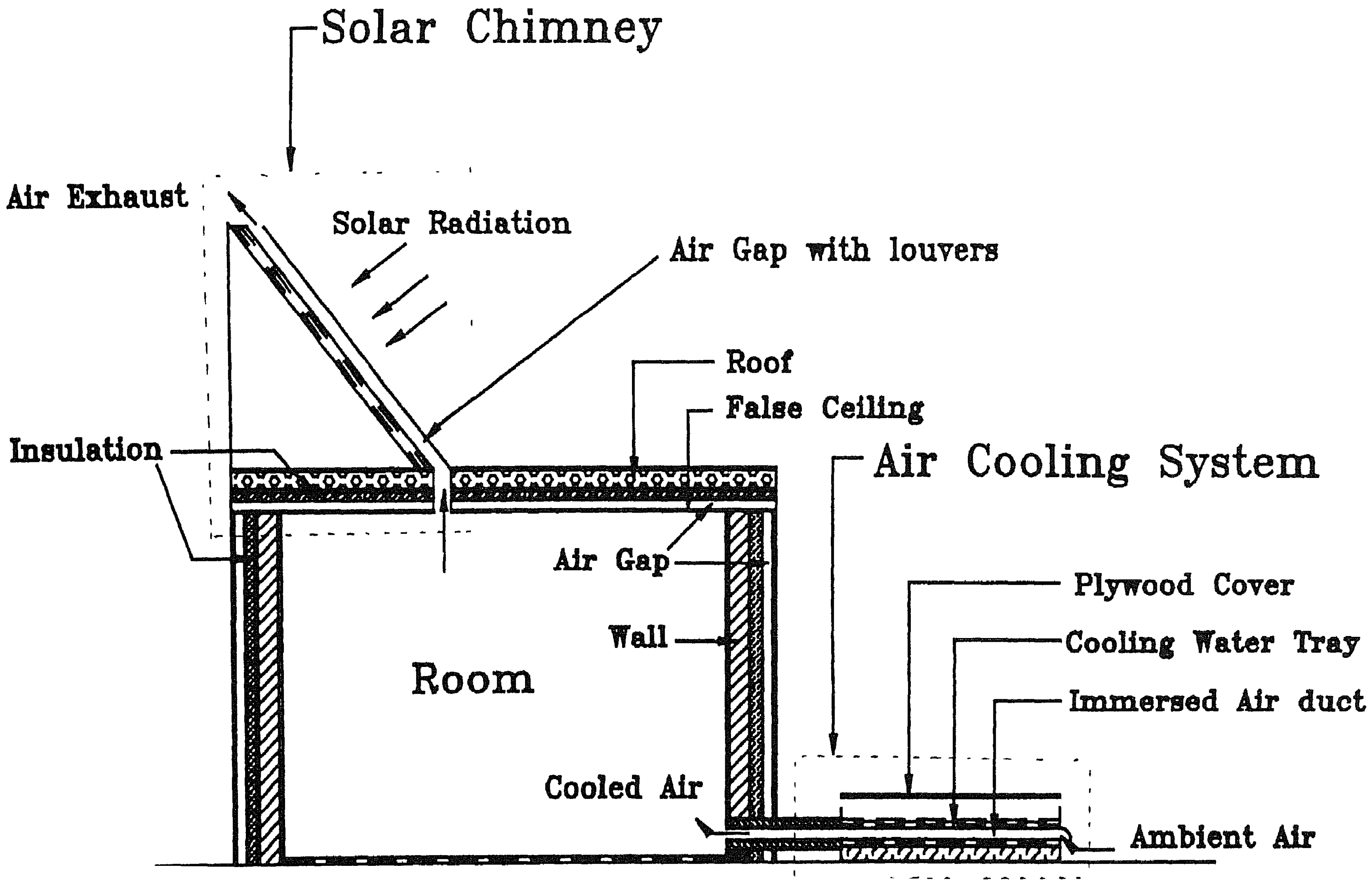


Figure 17 Complete view of the solar double chimney system in summer


Solar Chimney
Air Exhaust
Solar Radiation
Air Gap with louvers
Roof
False Ceiling
Insulation
Air Cooling System
Air Gap
Wall
Room
Plywood Cover
Cooling Water Tray
Immersed Air duct
Cooled Air
Ambient Air

7.3 Air heating system (for winter operation)

As described in the earlier sections, for composite climatic conditions, an ideal building design for thermal conditioning is one which can be easily converted for air cooling in summer and for air heating in winter season without much modification In order to convert water tray-air duct arrangement (for summer operation) into air heating system (for winter operation), the water in the tray was drained and the upward facing surface of air duct located in the water tray was painted black converting it into the absorber plate of air heating collector The plywood sheet placed on the water tray during summer season was replaced with a glass sheet with rubber beeding The modified configuration of the system for winter operation is shown schematically in Figure 19 This is different from the configuration in the original proposal (see Figure 5) as it was decided not to go for a set of separate solar chimneys at bottom. Instead, the air draft created by the top solar chimney now goes through the bottom solar chimney (horizontal solar air heating collector with air flowing below absorber plate) before entering into the room The air heating system for winter operation is shown in Figure 20 Figure 21 shows the complete system for winter operation

7.4 Building modifications

As described in the earlier section, various modifications were effected in the building in order to reduce the unitary thermal load by about 70% For this purpose, windows of the room were converted into double glazed type with horizontal partition This enables opening of the window during cool nights in summer season and warm days during winter season, if required The door of the room was modified by applying 1" thick thermocole layer and plywood from inside. A small antechamber was constructed in front of the south side door of the room in order to reduce the infiltration of ambient air into the room

In order to insulate the walls and the roof, thermocole is used as insulating material due to its good thermal resistance, low cost and ease in handling The inside surface of the room and outside surface of the room wall is lined with 1" thick thermocole sheets Wooden pegs (2" thick) were fixed on the surface in a staggered manner on walls and roof This helped in maintaining 1" air gap between insulation and false ceiling (in case of roof) or outside plaster layer (in case of wall). A plywood sheet (6 mm thick) was used as false ceiling A wiremesh was placed on the wooden pegs in the wall and a thin layer of plaster was applied so as to keep a 1" air gap between thermocole and outside plaster (see Figure 22) The resulting ferrocement outer sheath was subsequently cured and painted

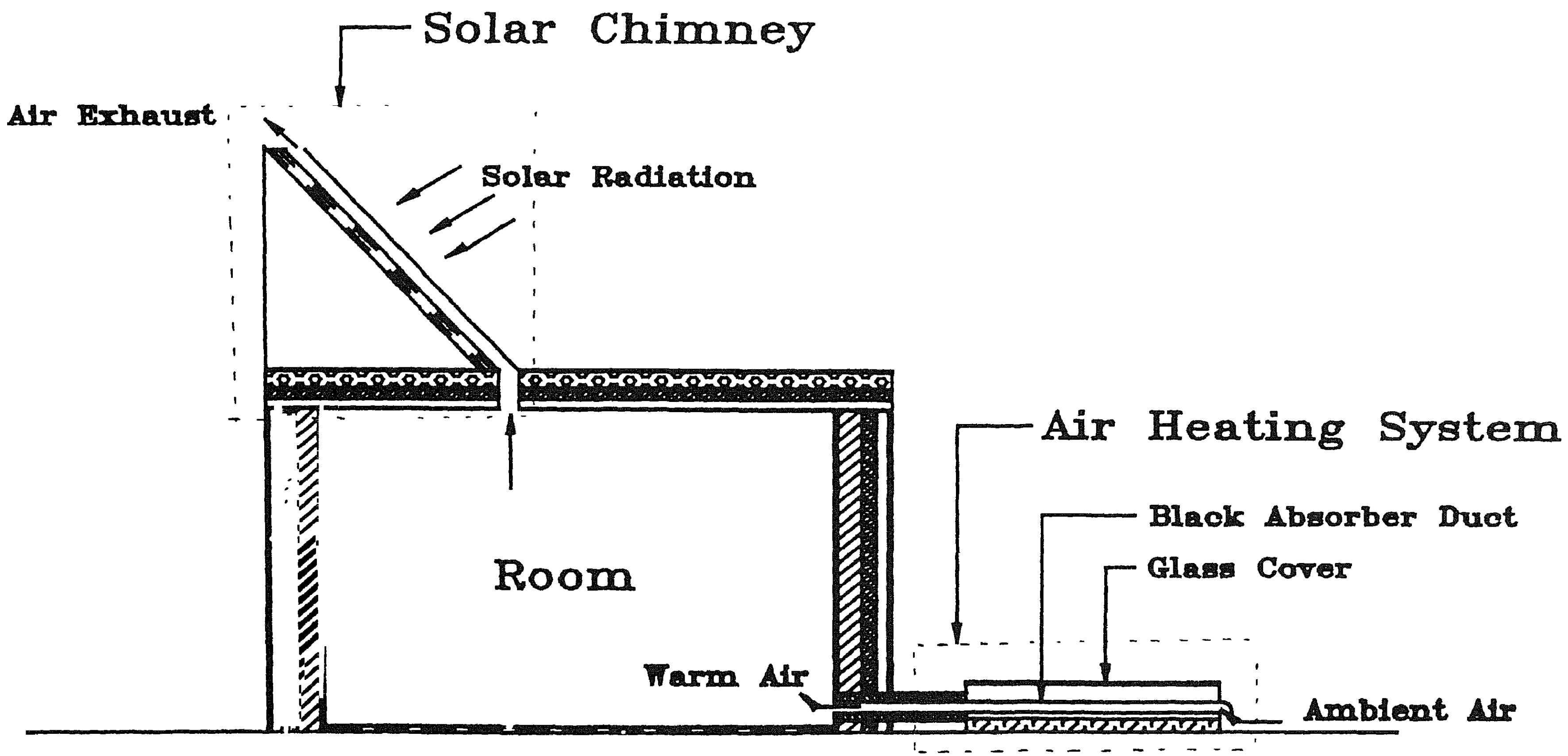


Figure 19· Schematic diagram of modified system for winter operation

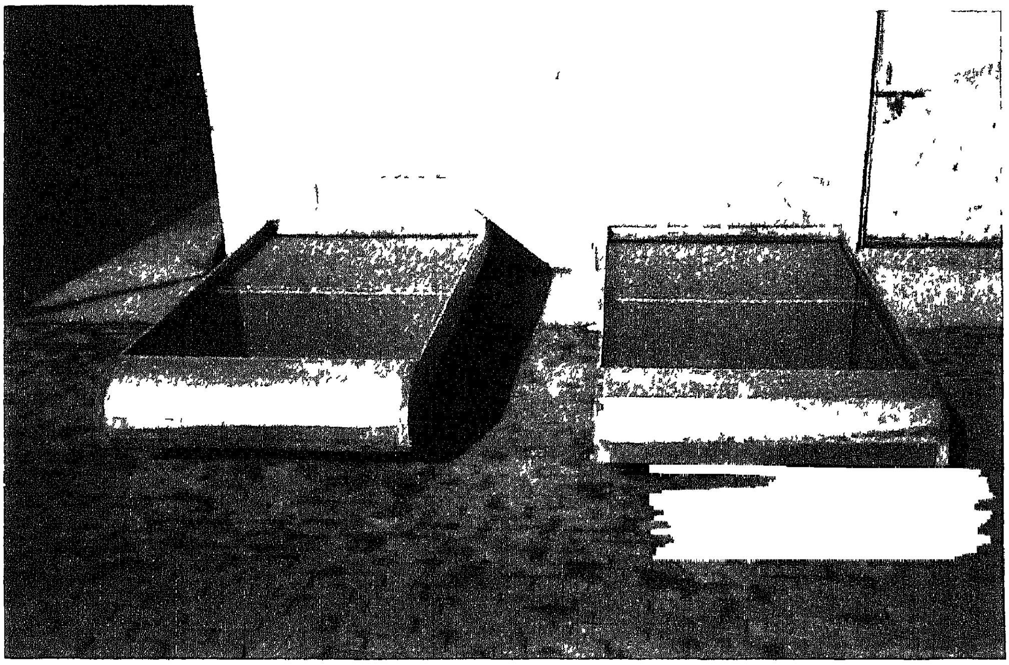


Figure 20 Air heating collectors for winter operation

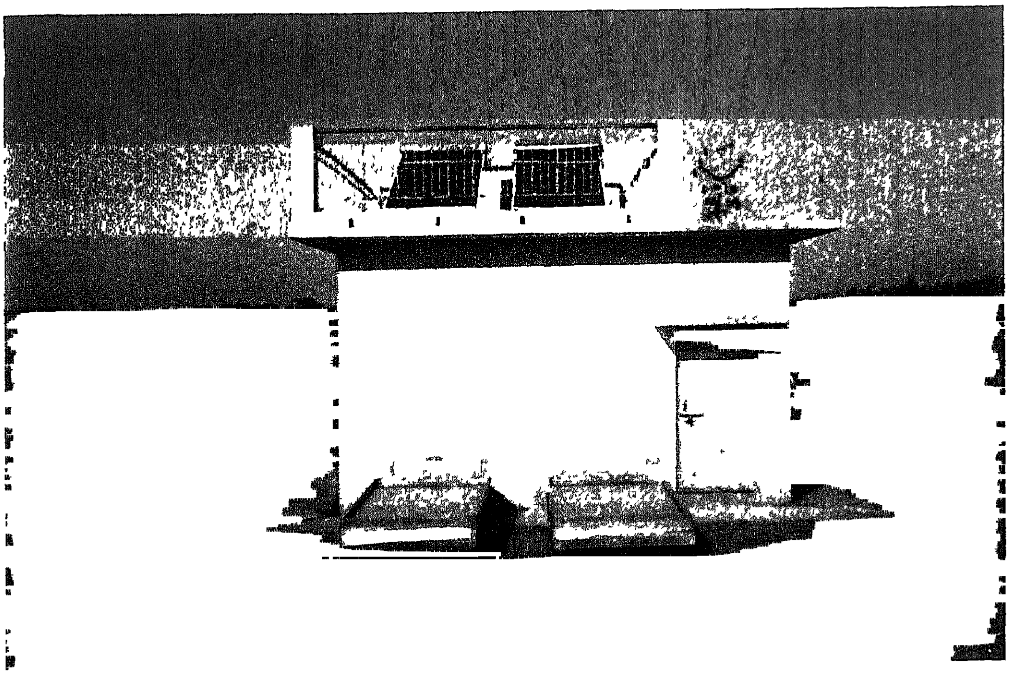


Figure 21 Complete view of the solar double chimney system in winter

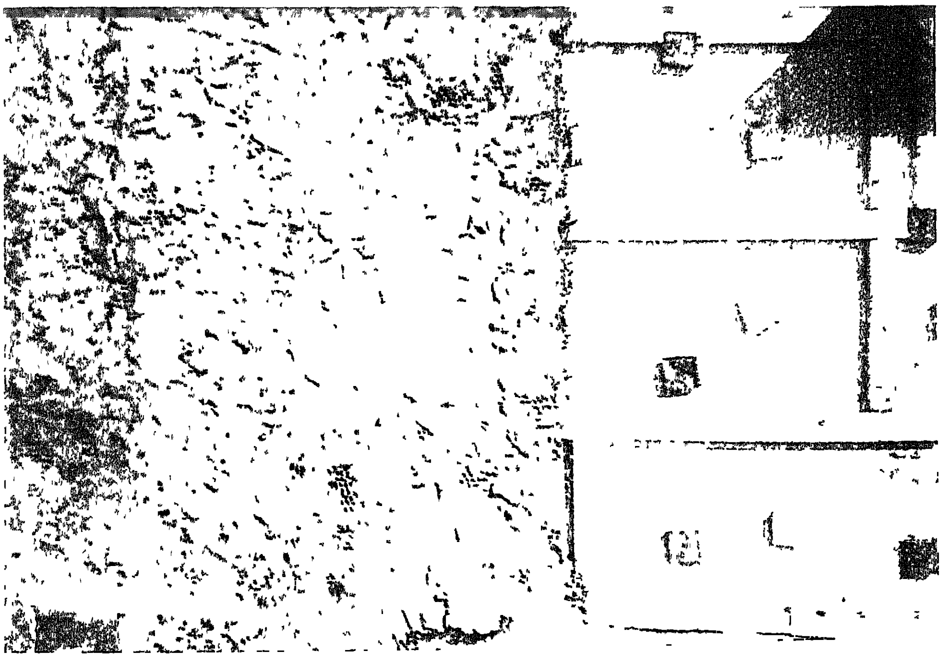


Figure 22 Wiremesh lining on wooden pegs in the wall to maintain 1" air gap betw thermocole insulation and ferrocement plaster

8.0 Performance Monitoring of the Prototype

As the project site is far from Delhi, at Gual Pahari on Gurgaon-Faridabad road, fabricators were reluctant to take up the job of fabrication of solar chimney, insulation work etc. This resulted in delay in fabrication and installation of solar chimneys, which was completed by May 1992. Shortly afterwards due to heavy storms at Gual Pahari, the chimney structure got damaged. This necessitated further rectification and installation work which went on till June end by which time the monsoon arrived and weather became cloudy and humid. Therefore, the summer performance could not be monitored effectively during 1992 requiring a project extension as the system had to be monitored for one complete year covering all seasons. Based on the feed-back obtained in preliminary monitoring of summer performance the system was further modified to improve its effectiveness. Thus the system was monitored for its performance for one complete calendar year starting from December 1992.

As an identical reference room was not available, a first floor room in the adjoining workshop was used as reference room. In order to monitor room temperatures continuously round the clock, one thermo-hygrograph each was located at the center of the room. Ambient temperature data was taken from Mausam Bhavan for the nearest weather monitoring station (Palam) to the project site. The details of the preliminary trials in summer 1992, and later monitoring for one complete calendar year i.e. from December 1992 to November 1992, results of air exchange rate measurements etc. are given in the following sections.

8.1 Air exchange rate (AER) tests

Air circulation rates in the room are generally very low and therefore difficult to measure with conventional instruments such as anemometers. The other method of measuring air flow rate handled by solar chimney is to close the outlet and provide a small opening, so that the air velocity through the opening will be higher so as to make it measurable by anemometer. But this increases the pressure drop, thereby changing the operating conditions and hence performance of the chimney. Therefore, the CO-decay method was used to measure the air circulation rate handled by solar chimney.

In this method the carbon monoxide (CO) concentration is artificially built up in the room by burning a small quantity of charcoal or by introducing producer gas from a gasifier. Once the CO concentration goes above 50-60 ppm the source of CO (burning charcoal) is removed from the room. Decay of CO concentration is then measured for 20-30 minutes. Assuming that CO concentration decays exponentially with time, the time constant is calculated from the slope of $\log_e$(CO) vs time plot from which the air exchange rate can be calculated. AER gives how many times volume of room air is replaced per hour. Air flow rate is then calculated by multiplying AER with the volume of the room. Experiments conducted in winter and summer season (1992-93) indicate that the solar air chimney gives AER values of the order of 4-5 Since the room size is 4 m x 5 m x 3 m the air flow rate handled by solar chimney works out to be around 240-300 m^3/hr Figure 23 shows details of one such AER experiment in graphical form The details of some of the AER experimental data in winter and summer seasons are summarized in Table 5

Table 5: Summary of Air Exchange Rate (AER) experiments

Date	Ambient temperature (°C)	Solar radiation (W/m^2)	Air exchange rate (hr^{-1})	Air flow rate (m^3/hr)
November 18, 1992	27 5	485	4 524	271 44
November 18, 1992	29 3	490	4 432	265 92
January 27, 1993	20 3	376	4 351	261 06
January 27, 1993	23 7	408	4 137	248 22
May 11, 1993	33 6	737	4 872	292 32
May 11, 1993	38 4	752	4 976	298 56

In order to visually see the air flow patterns within the room, specially at the room inlet and outlet ports, a smoke technique was used. Photograph in Figure 24 shows how the air enters into the room and spreads towards center of the room Since the room air inlet and outlet ports are located on opposite sides of the room, short circuiting of air path is prevented This also helped in reducing dead volumes Figure 25 shows the air streams converging from room volume and entering into the duct connecting the room to solar chimney

8.2 Evaporative cooling system

As discussed in the earlier sections, direct evaporative cooling (passing of air through a passage over cold water tray before entering the room) was tried first During June 4-6, 1992, the system was monitored for performance The parameters monitored included solar radiation intensity, ambient temperature and humidity, temperature of water in the cooling water tray, air temperature at the inlet of the room and at the center of the room A digital temperature indicator was used to measure the tray water temperature and a digital temperature and humidity indicator (portable type) was used for measuring ambient temperature and humidity A thermo-hygrograph was used to measure room air temperature and humidity and Suryamapi for measuring solar radiation intensity Since the system was not insulated at this time, heat load on the system was higher Figure 26 shows the cooling achieved in the water tray From the graph it can be seen that the water tray temperatures are almost 10-15°C lower than ambient temperature The tray temperatures were close to wet bulb temperatures indicating that sufficient air draft was present

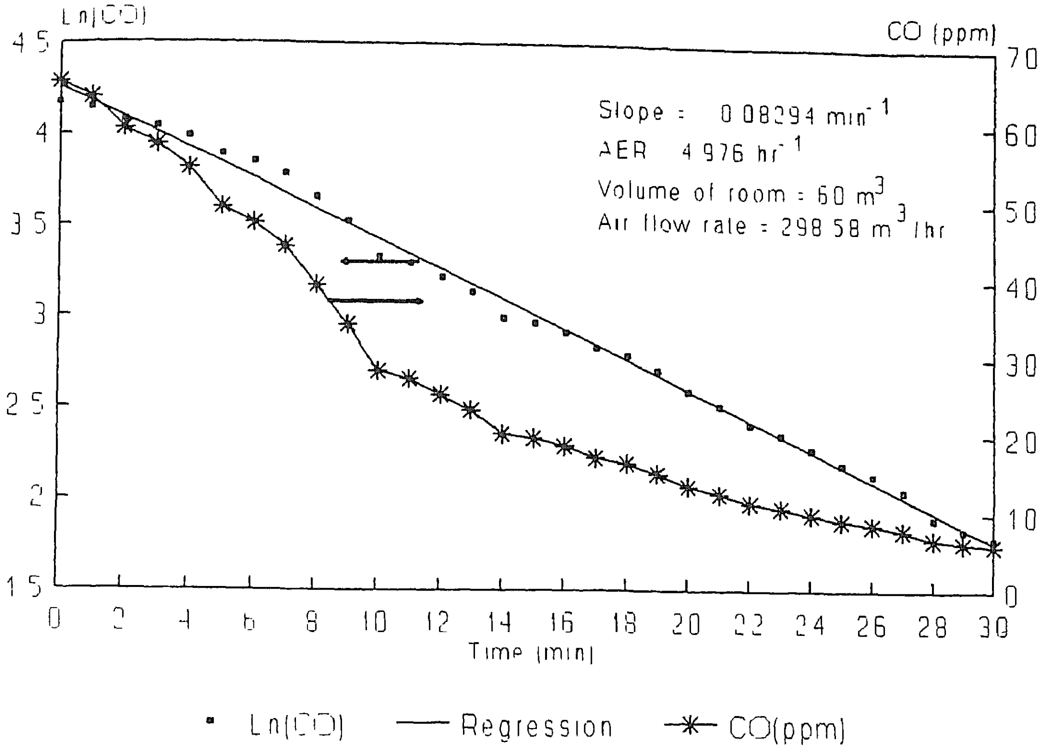


Figure 23 Air exchange rate test CO decay curve

Figure 24 Visualization of air stream pattern at room air inlet using smoke technique

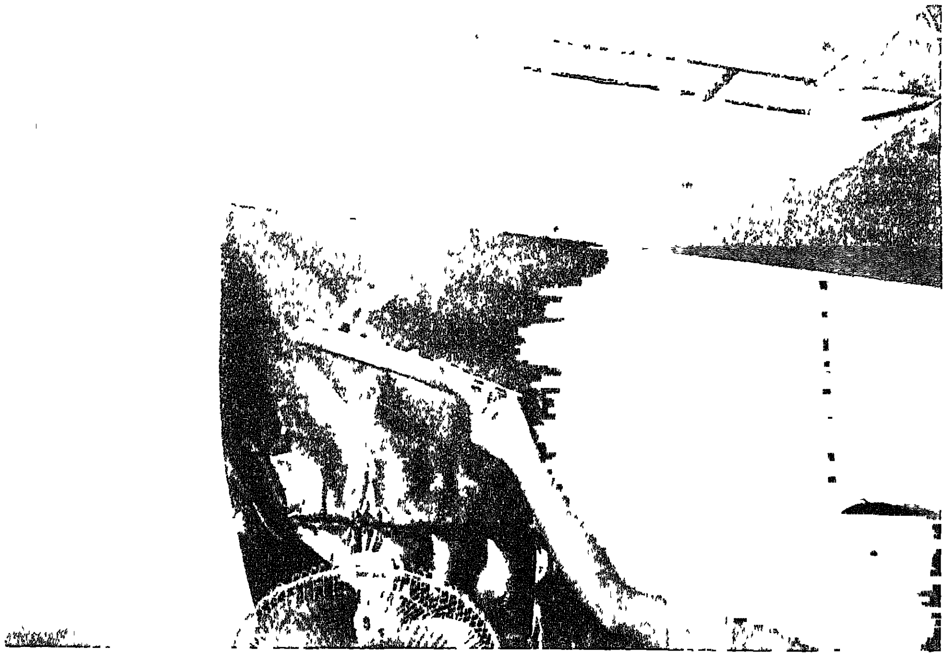


Figure 25 Visualization of air stream pattern at room air outlet using smoke technique

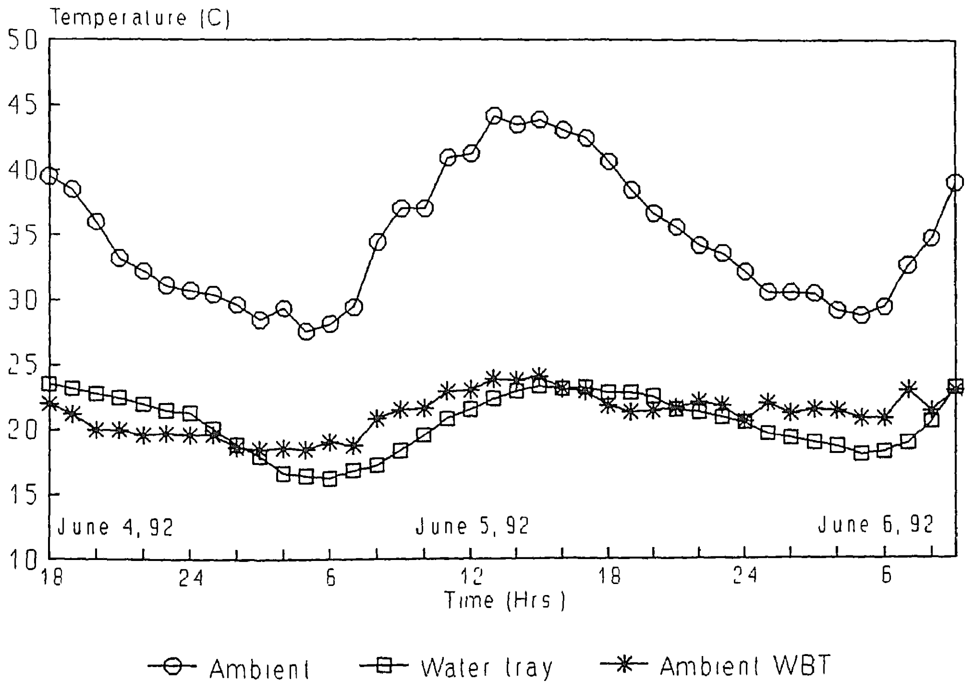


Figure 26. Summer performance Comparison of ambient and cooling water tray temperature

However, the cooling produced in the room was not significant, probably due to the high unitary load on the building It was also realized at this time that the direct evaporative cooling method would not be effective in the hot-humic months Hence a decision was taken to modify the cooling system and to reduce the unitary load of the building structure Meanwhile the cooling system was changed into a heating system as winter was approaching

8.3 Winter Performance (December 1992 - March 1993)

By the end of November 1992, the work of converting the water tray cooling system into an air heating system, as described in earlier sections, was completed. Thus it started supplying warm air to the room from the first week of December After that monitoring the room temperature was undertaken to study how effectively system performs in winter. Shutters are provided at the air inlet ports in the walls and air outlet ports in the roof. These are opened at around 9 30-10 00 a m in the morning and closed again at around 5 p m to avoid entry of cold air into the room during night

Figure 27 shows the performance of the system for the period of December 1992 to March 1993 The curves given in the figures are daily average temperatures for ambient air, reference room (workshop building), and solar chimney room Monitoring of the solar room began on December 5, 1992 and was stopped during December 17-23, 1992 for insulating the roof from inside The room wall insulation, from outside, was undertaken after that From the graphs, it can be seen that after completion of the insulation work, the difference between solar room and reference room started increasing, the solar room maintaining higher temperatures than the reference room The difference increased from 1.5-2 0°C at the start to 3°C after completion of roof insulation by mid-December and to over 4°C by December end when outside wall insulation was completed. The effectiveness of the system was prominently noticed during the peak cold wave period experienced at the site during 2nd and 3rd week of January 1993 During the cold wave period, the reference room temperature dropped in line with ambient with daily average temperatures of the order of 11-12°C The solar chimney room maintained its daily average temperature in the range of 19-20°C thereby keeping the room warmer by about 8°C compared to the reference room. This can be considered as comfortable for Delhi's winter climate.

During the later part of the winter season, the solar room temperature rose to 24-28°C, maintaining solar room warmer by 2-4°C compared to the reference room Performance curves for each month and the raw temperature data in tabular form are given separately in the Annexure

8.4 Transition to summer and hot-dry summer season (April 1993 - July 1993)

Figure 28 shows the comparative performance of solar chimney system When the ambient and solar room temperature crossed the comfortable temperature level of about 27°C, the air heating system is converted into air cooling system as described earlier i e by filling water in the trays and replacing the glass sheet with plywood sheet keeping an air gap

The effect of performance transition of the system, from air heating to air cooling can be clearly observed from the graphs After converting the system, the difference between solar and reference room diminished and the two curves crossed over (solar room temperature curve went down the reference room temperature curve) in the 3rd week of April 1993

Performance of the system was satisfactory, but was not up to expectation during the summer season During the hot-dry season, solar room maintained lower temperatures compared to reference room by 2-3°C and it was as high as 4-5°C in the middle of May 1993 The sharp dips in the temperatures during the middle and end of May 1993 are due to sudden showers experienced at the site. During the later half of the summer season, the humidity level in the ambient increased This resulted in less evaporation of water from the cooling tray, thereby reducing its cooling effect This resulted in the frequent crossing of the temperature curves of solar and reference rooms Low temperature levels (26-28°C) were observed during the month of July 1993 due to frequent showers The performance curves for individual months and raw tabulated data are given separately in the annexure

8.5 Hot-humid summer, transition to winter season (August 1993 - November 1993)

Comparative performance curves for the period of August 1993 to November 1993 (representing hot-humid season and transition to winter season) are shown graphically in Figure 29. During the night period in the hot-humid days, when ambient temperature is relatively lower, windows of the room were kept open to take advantage of temperature difference.

During the month of October, the ambient temperature started dropping indicating beginning of the winter season The solar room was about 2°C warmer (in terms of daily average temperature) in October and the difference increased as the severity of winter increased By the end of November 1993, when the reference room temperature dipped to 18-19°C, the solar room maintained its temperature in the range of 24-26°C thus giving a difference in temperature of the order of 6-8°C

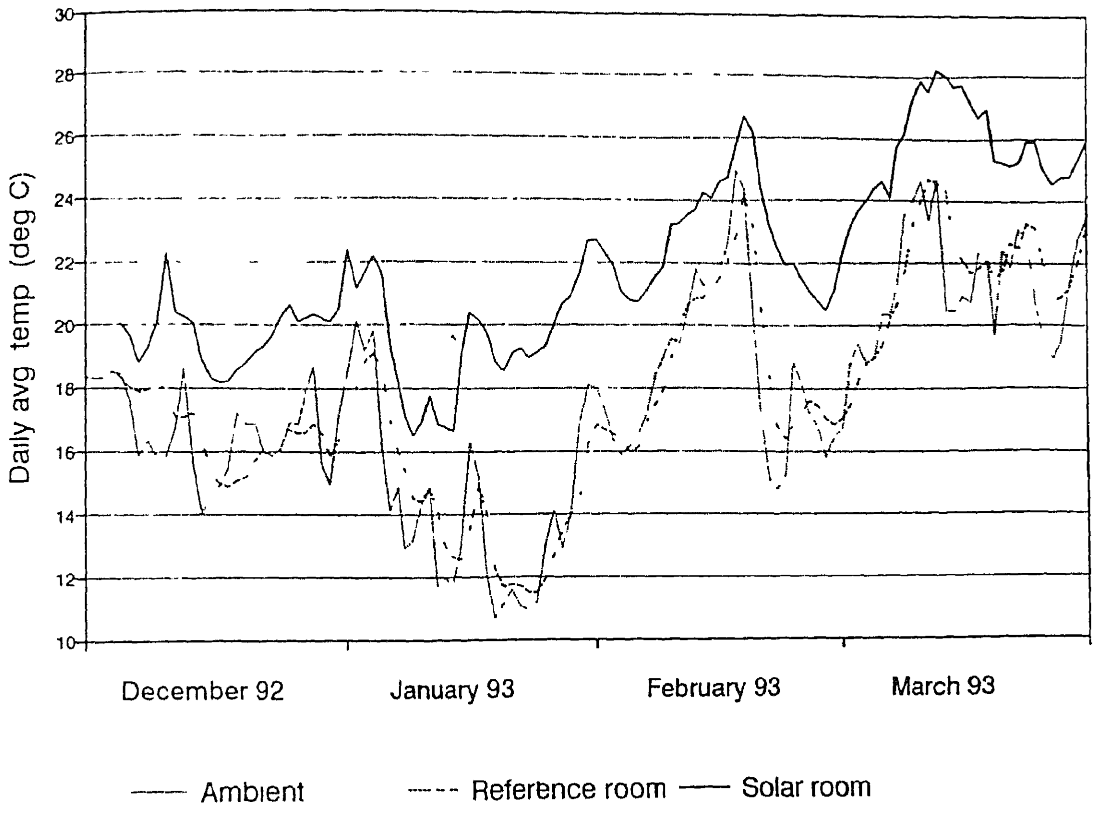


Figure 27 System performance comparison curves for the period December 1992 to March 1993 (winter operation and transition to hot-dry season)

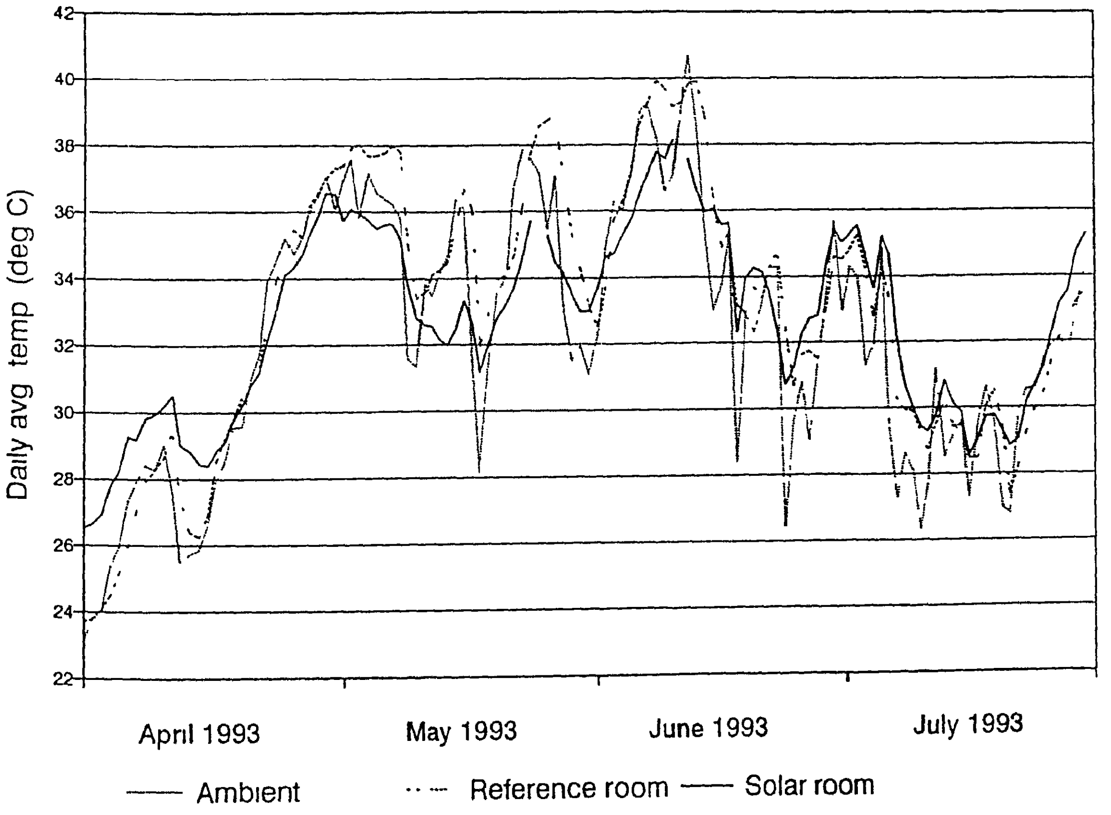


Figure 28 System performance comparison curves for the period April 1993 to July 1993 (hot-dry summer season and transition to hot-humid summer)

The performance for the complete year is shown in Figure 30 It can thus be summarized that the solar chimney system performance was very good during winter season, satisfactory in hot-dry season and less effective in hot-humid conditions Also, it is easy to switch over its configuration of the system for summer and winter operation which is desirable for any solar passive design for composite climates

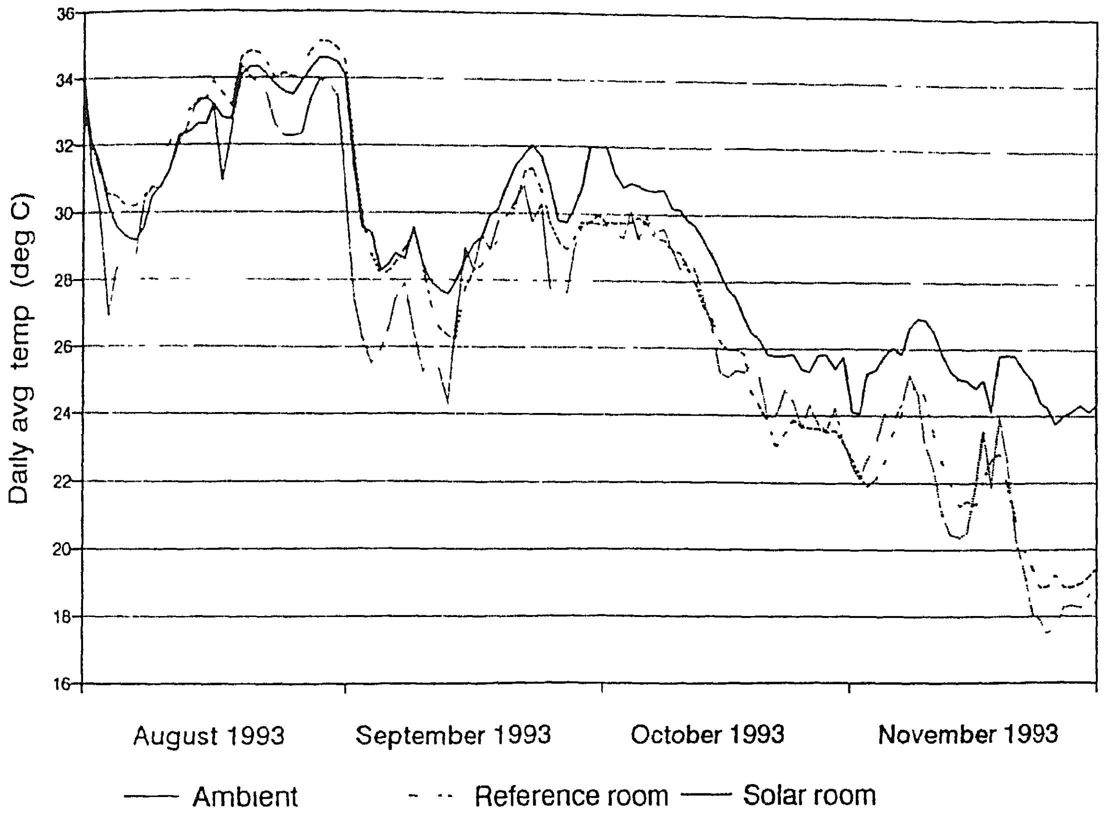


Figure 29 System performance comparison curves for the period August 1993 to November 1993 (hot-humid summer season and transition to winter season)

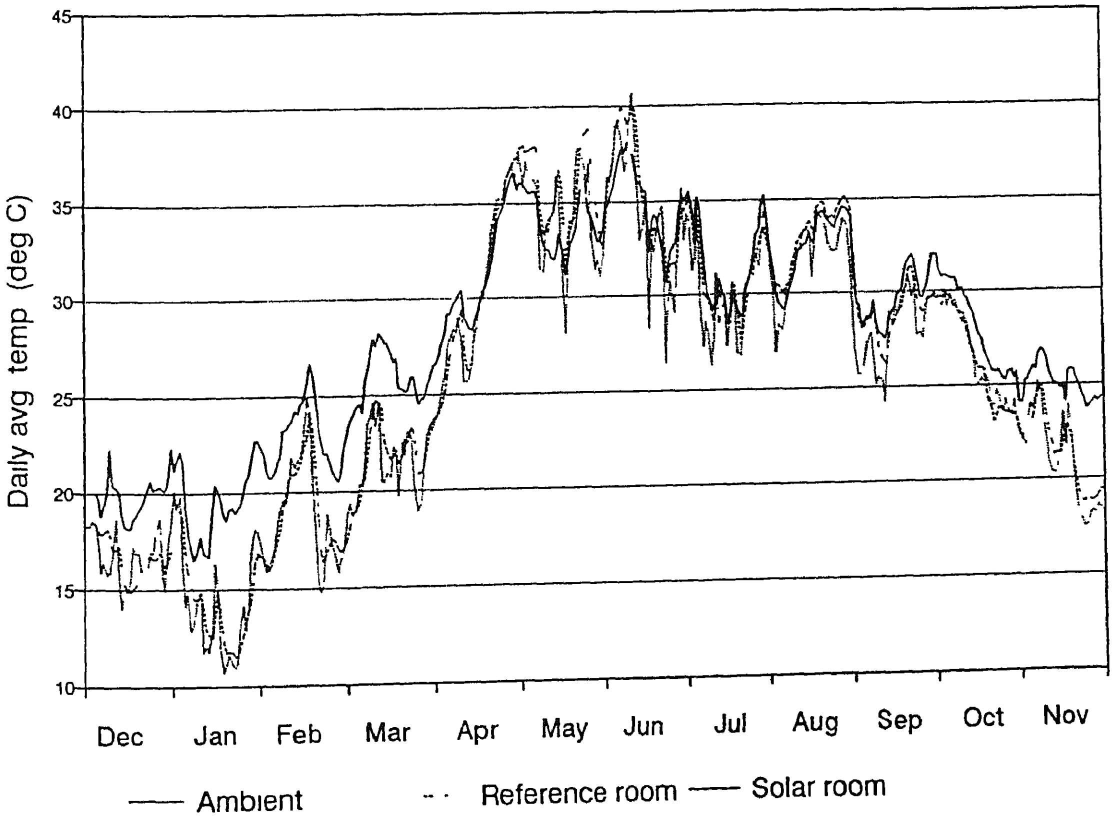


Figure 30 System performance comparison curves for complete calendar year (December 1992 - November 1993)

9.0 Scope for Future Work

As discussed in the previous chapter, the solar chimney system performed very well during winter season but its summer performance was not up to the expectation The reason for this can perhaps be due to under-sizing of the solar chimneys In the present system, the cooling water trays are located on the ground and occupy significant space, which may not be available in all the cases. Also, the horizontal positioning of the air heating system in winter does not give optimum performance as the angle of incidence of solar radiation in winter is quite low Thus, there is possibility of improving the winter performance of the system further

9.1 Proposed improved system

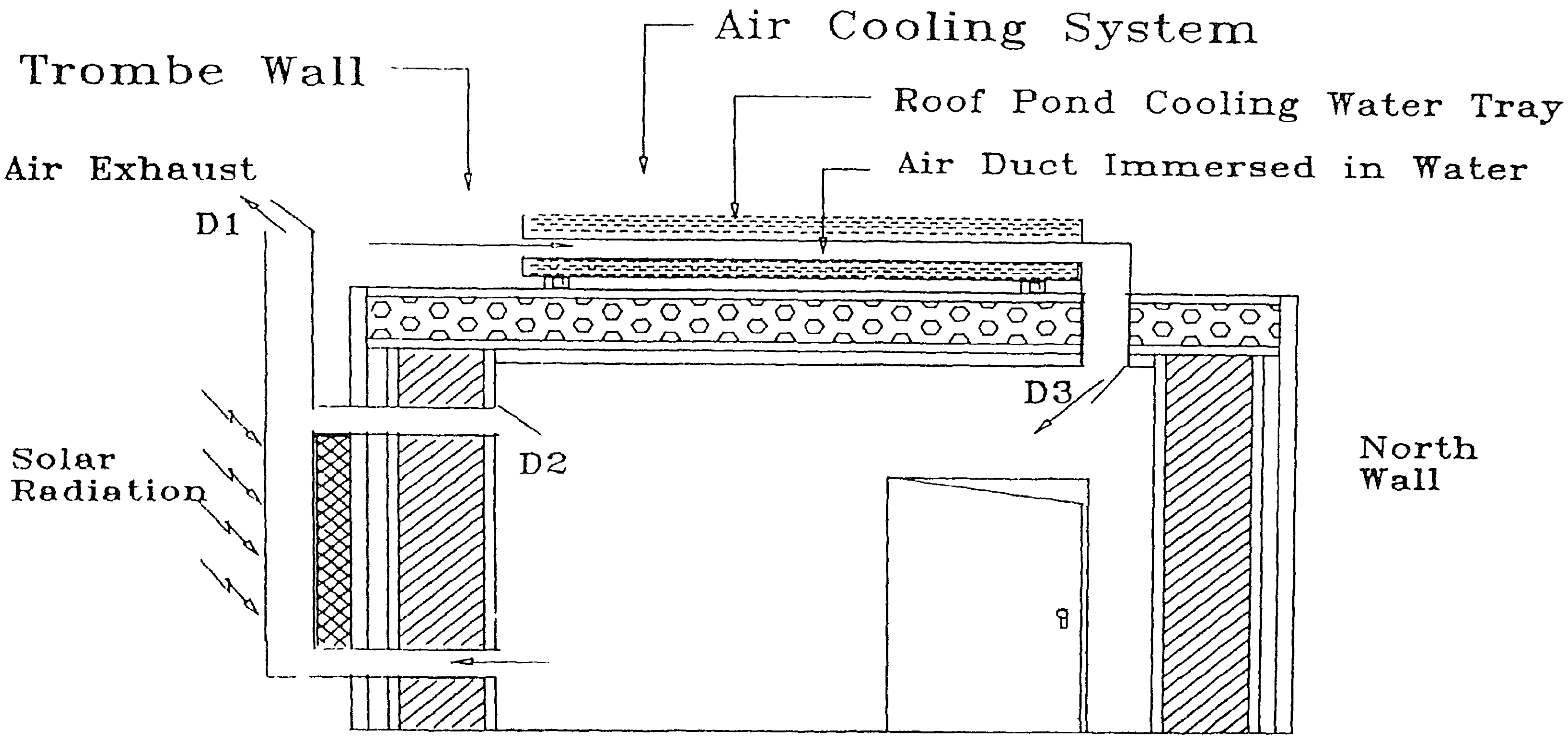
The schematic diagram of the improved passive system is shown in Figure 31 This system integrates the roof cooling technique and trombe wall concept The south side wall is converted into trombe wall by providing vertical glazing heater A suitable roof cooling system such as the roof pond or sack cloth system will be placed on the roof and some arrangement will be made to thermally link an air ducting system to the roof cooling system Ambient air drawn through the duct will be cooled and sucked into the room when needed

9.1.1 Winter operation

During the winter operation, the dampers D1 and D3 shown in Figure 31 are closed and water in the trays located on the terrace is drained The vertical air heater (trombe wall) on the south wall takes the room air from bottom, which passes up vertically over hot absorber surface and gets heated up The hot air thus obtained enters the room from the top opening D2 If some ventilation is required (for example, if temperature shoots up beyond comfortable range) it can be obtained by adjusting the opening of dampers D1 and/or D3 The vertical collector built in the south wall avoids separate horizontal collectors, as is the case in the present system Also, due to its vertical orientation, it intercepts more solar radiation during winter resulting in higher effectiveness This also helps in improving the aesthetic look of the building.

9.1.2 Summer operation

For the summer operation of the system, damper D2 is closed and D1 and D3 are kept open Now, the south wall air heater acts like a chimney, sucking air from room and throwing it out. Air is sucked into the room through damper D3, which brings ambient air through the duct immersed into the water in the trays installed on the roof The advantage of roof pond is that it reduces heat load on the building significantly and since large heat transfer areas can be made available, its effectiveness in cooling air is expected to be much higher than that of the present system.



Summer operattion: Damper D2 closed, D1 & D3 open
Winter operation: Dampers D1 & D3 closed, D2 open

Figure 31 Schematic diagram of proposed improved passive system

As the both air heating and cooling components of the system can be in-built into the building design, it does not require additional space. If the year-round performance of the system is satisfactory there is a distinct possibility that the system would be also economically viable. The improved system can be installed and studied either as phase II of the current project or as a separate project funded by MNES

10.0 Conclusions

The concept of using a solar double chimney system for thermal conditioning of buildings in composite climates has been tested successfully through an year-round performance monitoring of the system and comparison with a reference conventional system The prototype system consisting of solar chimneys, air heating and cooling units and suitable air admitting ports was fabricated and installed along with proper retro-fitting to reduce the unitary heat load The salient features of the system are its ability to adjust quickly for summer as well as winter operation, and the fact that it does not need any external conventional energy input The system provides warm air during winter, cool air during hot-dry summer and ventilation during hot-humid seasons

A computer simulation model for estimating the air flow rate handled by solar chimneys, which can be used for its sizing, has been developed The same can be extended for sizing of natural convection solar air heaters used for space heating, crop drying, etc A computer programme for determining the area of water trays required for the air cooling system has also been developed

The performance of the system was monitored for one complete calendar year i e from December 1992 to November 1993 Winter performance of the system was very good achieving a temperature (daily average) 7-8°C warmer than the reference room during 1993 winter Even during severe cold wave conditions the solar room maintained a comfortable temperature (above 20°C) The summer performance of the system was satisfactory during hot-dry months giving average room temperatures lower by 2-4°C in comparison to the reference room, but it was not satisfactory during the hot-humid months

Based on the experience gained during this project, an improved system is proposed for continuing future research work in this area Both the trombe wall and roof pond cooling concept are incorporated in the proposed system in order to make it more effective and also to give a more compact and aesthetic appearance

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ANNEXURE

Performance comparison of solar chimney system
and
hourly ambient, reference conventional and
solar chimney room temperature data

December 1992

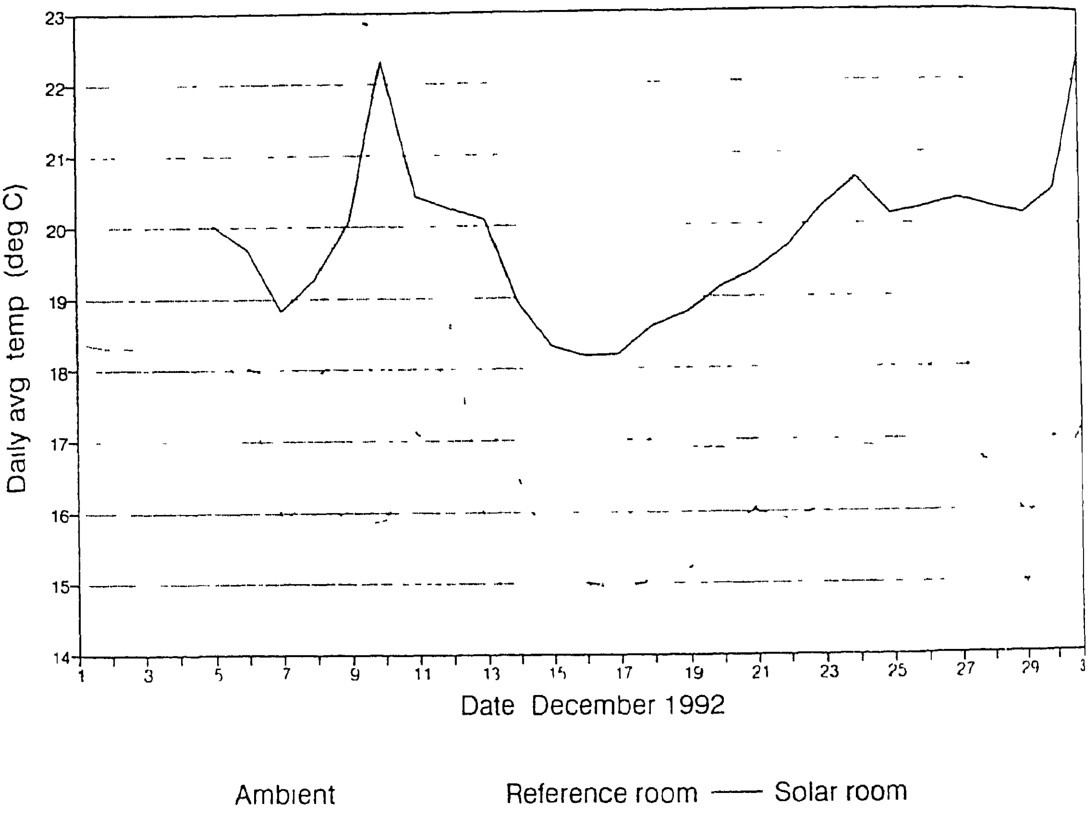

Figure: Comparative performance monitoring of solar chimney system for December 1992

Table: Hourly ambient temperature data for December 1992

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	15.4	15.3	14.9	14.7	14.1	13.7	13.7	13.6	13.7	16.3	20.0	22.2	23.0	23.2	24.2	24.2	23.7	23.7	20.5	19.6	18.8	18.1	17.6	17.0	18.38
2	16.4	16.2	15.5	15.3	14.8	14.2	13.2	13.3	13.5	15.8	18.6	21.2	22.8	23.1	23.6	23.9	23.6	23.6	20.7	19.3	18.5	18.0	17.6	16.6	18.30
3	15.8	15.3	15.0	15.0	14.6	14.4	14.5	14.3	14.4	15.5	17.6	20.0	21.6	22.6	23.1	23.2	23.0	23.0	21.1	20.5	19.6	19.0	18.4	17.8	18.30
4	17.1	16.5	16.2	15.4	14.8	14.6	14.5	14.6	15.2	17.6	18.2	19.6	21.8	23.0	23.6	23.6	23.2	23.2	20.6	19.8	18.6	18.1	17.4	16.6	18.49
5	15.7	15.6	15.6	15.6	15.3	14.6	14.4	14.2	13.6	15.9	18.7	21.0	22.5	23.0	23.8	23.8	23.4	23.4	20.7	19.7	19.0	18.4	17.6	17.3	18.45
6	16.6	16.3	15.5	14.3	13.8	13.3	13.0	13.0	12.9	15.0	18.2	20.9	21.5	22.2	23.0	23.2	23.2	23.2	21.1	18.4	17.0	16.2	15.5	15.2	17.61
7	13.6	13.4	12.8	12.3	11.4	11.0	10.5	10.2	10.0	12.4	15.1	17.4	19.6	21.3	22.1	22.4	22.4	22.4	20.0	17.7	17.1	15.8	15.2	14.8	15.87
8	14.3	13.2	12.5	12.1	11.6	11.2	10.3	10.2	10.0	12.6	15.5	18.1	19.9	21.4	22.5	23.0	23.2	23.2	21.1	18.7	17.7	16.8	16.4	16.3	16.33
9	15.1	14.6	14.0	13.1	12.4	11.7	11.3	11.0	10.6	10.8	12.8	12.9	12.2	18.4	22.0	22.2	23.7	23.7	21.5	19.9	17.6	16.4	15.6	14.9	15.77
10	14.2	13.7	13.1	12.4	12.6	11.9	10.4	9.4	9.1	16.1	16.4	18.1	20.2	21.3	22.0	22.1	22.2	22.2	19.0	17.1	15.5	15.0	14.0	13.5	15.90
11	12.8	12.4	11.9	11.1	10.7	10.3	10.1	9.9	10.2	12.8	15.8	19.6	23.1	24.0	24.9	25.0	24.6	24.6	20.6	18.6	17.9	17.2	17.1	16.4	16.73
12	15.8	15.9	15.8	15.3	14.6	14.6	14.0	13.9	14.8	18.7	18.6	20.0	21.8	23.2	24.2	24.7	24.7	24.7	21.8	19.5	18.3	18.0	17.8	16.8	18.65
13	15.0	14.0	13.5	13.4	13.2	11.7	10.8	10.6	10.6	11.6	14.2	16.6	19.1	20.6	21.5	21.6	21.6	21.6	19.3	16.5	15.4	14.9	13.7	12.7	15.57
14	11.6	10.8	10.5	9.9	9.5	8.8	8.1	7.6	7.1	9.5	13.1	15.9	18.8	19.8	20.5	20.9	21.0	21.0	17.3	18.8	14.8	14.1	13.7	13.4	14.02
15	12.3	11.8	11.1	10.7	10.0	9.4	8.8	8.7	8.3	11.4	14.5	16.7	19.3	20.0	20.8	21.1	21.3	21.3	19.0	16.5	15.5	15.0	14.1	13.4	14.63
16	13.1	12.4	11.5	11.1	10.5	10.1	10.0	9.9	9.9	11.6	14.0	16.3	18.7	21.6	21.4	21.5	21.6	21.6	19.2	16.6	15.2	14.1	13.5	12.6	14.92
17	11.8	11.5	10.8	10.5	10.3	9.7	9.5	9.3	9.4	12.1	15.0	19.2	21.8	22.1	22.1	22.3	22.2	22.2	19.5	17.9	16.5	15.3	15.2	14.7	15.45
18	14.0	12.6	12.0	11.6	11.6	11.5	11.5	11.4	10.5	15.2	18.7	21.0	24.1	23.9	24.6	25.6	25.1	25.1	20.2	18.4	17.6	16.4	15.9	14.5	17.21
19	14.2	14.0	13.6	13.6	13.5	12.1	11.6	11.2	11.5	14.0	17.7	20.7	22.1	22.2	23.0	22.7	22.2	22.2	19.1	18.2	17.2	16.8	16.1	15.7	16.88
20	15.0	14.7	14.0	12.5	11.3	11.3	11.0	10.8	10.8	13.8	16.8	19.8	22.1	22.6	23.0	23.1	23.0	23.0	21.0	19.5	16.7	15.6	16.2	15.2	16.87
21	14.5	14.1	13.0	12.3	11.7	11.0	10.0	9.8	9.3	11.3	14.4	17.2	19.5	21.4	23.0	23.2	23.3	23.3	20.0	18.4	16.7	16.3	15.6	14.6	16.00
22	13.6	13.1	12.4	11.2	10.4	9.6	9.1	9.1	9.0	11.0	14.8	18.1	20.4	21.7	22.9	23.4	23.7	23.7	20.3	19.2	17.4	16.7	15.3	14.9	15.88
23	14.5	13.9	12.9	12.4	11.3	10.3	10.1	10.0	10.0	12.0	14.5	17.0	19.5	21.1	22.3	23.1	23.7	23.7	20.6	18.5	17.4	17.0	15.4	14.8	16.08
24	14.3	13.8	13.0	12.1	11.2	11.1	11.1	11.0	11.2	15.0	17.3	20.4	23.0	23.1	23.2	23.5	23.6	23.6	20.6	18.1	17.2	16.5	16.5	15.4	16.91
25	14.2	13.5	12.9	12.2	11.5	11.4	11.2	11.1	10.9	13.3	16.8	19.3	21.5	22.8	23.9	24.2	24.1	24.1	21.8	19.0	17.7	16.8	16.0	15.0	16.88
26	14.5	14.4	14.3	13.4	12.6	12.5	12.5	11.8	11.9	15.6	17.5	20.6	23.7	24.0	25.5	25.5	25.4	25.4	21.8	19.0	17.9	17.3	16.9	15.8	17.91
27	15.1	15.1	14.9	14.2	13.9	14.0	14.4	14.4	14.5	15.7	19.2	20.4	22.2	23.2	25.8	25.8	25.7	25.7	21.6	20.5	19.3	18.5	17.7	17.1	18.70
28	16.2	14.7	13.3	13.0	11.9	11.1	10.7	10.4	9.9	11.5	13.2	16.6	19.5	21.5	22.0	22.4	22.3	22.3	19.0	16.6	15.3	15.2	14.2	12.5	15.64
29	11.8	11.4	10.6	10.2	10.0	9.4	8.9	8.8	9.0	10.7	13.5	16.3	18.9	20.5	21.5	22.0	22.2	22.2	19.7	18.0	17.1	16.0	15.3	14.7	14.95
30	14.5	13.7	13.0	12.6	12.3	12.2	12.1	12.1	12.1	12.8	17.0	19.6	22.0	23.1	23.6	23.8	23.8	23.8	21.7	19.2	17.7	17.0	16.1	15.3	17.13
31	15.1	14.9	14.5	14.1	13.6	13.2	13.2	13.1	13.5	15.8	20.6	22.6	24.2	24.7	25.5	25.4	25.2	25.2	22.5	20.1	18.0	17.1	16.6	16.6	18.55

Table: Hourly reference conventional room temperature data for December 1992

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	•	•	•				•				•				•		•		•	•	•	•	•	•	0 00
2	•			•		•					•			•						•		•	•	•	0 00
3	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	0 00
4	18 3	18 3	18 3	18 2	18 2	18 1	18 1	18 3	18 5	18 5	18 5	18 7	18 8	18 8	18 8	18 8	18 8	18 8	18 8	18 8	18 8	18 8	18 6	18 6	18 55
5	18 6	18 6	18 5	18 5	18 2	18 1	18 1	18 1	18 1	18 1	18 1	18 1	18 1	18 3	18 5	18 5	18 5	18 5	18 5	18 5	18 5	18 5	18 5	18 3	18 35
6	18 2	18 2	18 1	18 1	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 03
7	18 0	18 0	17 8	17 8	17 8	17 5	17 5	17 5	17 5	17 5	17 8	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	17 86
8	18 0	17 9	17 8	17 8	17 8	17 8	17 8	17 5	17 5	17 8	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	17 90
9	18 0	18 0	17 8	17 8	17 5	17 5	17 5	18 0	18 0	18 5	19 0	19 0	19 0	19 0	19 0	18 5	18 2	18 2	18 2	18 2	18 1	18 0	18 0	18 0	18 21
10	18 0	18 0	17 8	17 8	17 8	17 5	17 5	17 5	17 5	17 5	17 8	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	18 0	17 86
11	17 5	17 3	17 2	17 1	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 1	17 2	17 2	17 2	17 1	17 0	17 0	17 0	17 0	17 0	17 08
12	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 1	17 1	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 08
13	17 2	17 2	17 2	17 2	17 2	17 2	17 2	17 1	17 1	17 0	17 0	17 0	17 0	17 2	17 2	17 4	17 5	17 5	17 5	17 5	17 5	17 4	17 2	17 2	17 24
14	17 2	17 1	17 0	17 0	17 0	17 0	17 0	17 0	16 6	16 5	16 5	16 5	16 5	16 5	16 3	16 0	16 0	16 0	16 0	16 0	15 8	15 5	15 5	15 5	16 42
15	15 2	15 0	14 8	14 8	14 8	14 8	14 8	14 8	14 8	14 8	14 8	15 0	15 5	16 0	16 0	16 0	15 8	15 8	15 8	15 8	15 5	15 3	15 3	15 2	15 27
16	15 2	15 1	15 0	14 8	14 6	14 5	14 5	14 5	14 5	14 5	14 5	15 0	15 0	15 0	15 0	15 2	15 2	15 3	15 5	15 5	15 6	15 5	15 5	15 2	15 01
17	15 1	15 1	15 1	15 1	14 8	14 5	14 5	14 5	14 8	15 0	15 2	15 5	15 2	15 2	15 2	15 2	15 2	15 2	15 0	14 8	14 5	14 3	14 2	14 0	14 88
18	14 0	14 0	14 0	14 5	15 0	15 5	15 8	16 0	15 8	15 8	15 5	15 5	15 5	15 3	15 3	15 3	15 2	15 2	15 0	15 0	15 0	14 5	14 5	14 5	15 07
19	14 5	14 8	15 0	15 0	15 0	15 0	15 0	15 0	15 2	15 5	15 5	15 5	15 5	15 5	15 5	15 6	15 5	15 5	15 3	15 2	15 0	15 0	15 0	15 0	15 19
20	15 0	15 0	15 0	15 0	15 5	15 8	16 0	16 0	16 0	16 0	16 0	16 0	16 0	16 0	16 0	16 0	16 0	16 0	16 0	15 8	15 5	15 5	15 5	15 3	15 70
21	15 3	15 5	15 5	15 5	16 0	16 2	16 2	16 2	16 5	16 5	16 5	16 5	16 5	16 3	16 3	16 3	16 3	16 3	16 2	16 1	16 0	15 8	15 5	15 5	16 06
22	•	•	•	•		•	•		•		•		•	•	•	•	•			•	•	•	•	•	0 00
23	17 0	16 8	16 5	16 5	16 2	16 2	16 0	16 0	16 0	16 0	16 5	16 5	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	16 68
24	16 8	16 8	16 5	16 5	16 2	16 0	16 0	16 0	16 0	16 0	16 2	16 5	17 0	17 2	17 5	17 5	17 2	17 0	17 0	17 0	17 0	17 0	17 0	16 8	16 70
25	16 8	16 6	16 5	16 3	16 2	16 0	16 0	15 8	15 8	16 0	16 0	16 8	16 8	16 8	16 8	16 8	16 8	17 0	17 0	17 0	17 0	17 0	17 0	17 0	16 58
26	16 8	16 6	16 5	16 3	16 2	16 1	16 0	16 0	16 0	16 0	16 0	16 3	16 8	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	16 61
27	17 0	17 0	16 8	16 6	16 5	16 5	16 5	16 3	16 3	16 3	16 5	17 0	17 1	17 2	17 2	17 2	17 5	17 5	17 5	17 5	17 0	17 0	18 5	18 5	16 88
28	16 5	16 5	16 5	16 5	16 8	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	17 0	16 8	16 6	16 2	16 1	16 0	16 0	15 8	15 5	16 62
29	15 5	15 5	15 5	15 5	16 0	16 2	16 2	16 2	16 2	16 2	16 2	16 2	16 2	16 2	16 2	16 1	16 0	16 0	16 0	15 8	15 5	15 3	15 3	15 3	15 89
30	16 0	16 0	15 9	15 8	15 6	15 4	15 3	15 2	15 4	15 7	16 0	16 5	16 4	16 4	16 4	17 0	17 5	17 5	17 3	17 2	17 1	17 0	17 0	17 0	16 36
31	17 0	17 0	16 9	16 8	16 7	16 6	16 4	16 2	16 1	16 0	16 0	16 5	17 0	17 5	18 0	18 0	18 0	18 0	17 9	17 9	17 8	17 8	17 8	17 8	17 15

Table: Hourly solar chimney room temperature data for December 1992

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	•	•				•					•														0.00
2																									0.00
3																						•	•	•	0.00
4	•				•	•	•										•				•	•	•	•	0.00
5	20.2	20.0	19.8	19.3	19.0	19.0	18.8	18.5	18.0	17.8	18.0	18.5	19.0	20.0	21.0	21.5	22.0	22.2	22.0	22.0	21.3	21.0	21.0	20.8	20.03
6	20.5	20.2	20.0	19.8	19.3	19.0	18.5	18.3	18.0	17.5	17.5	18.0	19.5	19.0	19.5	20.0	20.5	21.5	22.0	21.3	21.0	21.0	20.5	20.0	19.68
7	20.0	19.5	19.0	18.8	18.2	18.0	17.5	17.0	16.8	16.5	16.2	17.0	17.5	18.0	18.5	19.0	20.0	21.0	21.0	21.0	20.5	20.5	20.2	20.0	18.82
8	20.0	19.8	19.2	19.0	18.5	18.2	18.0	17.5	17.0	17.0	17.2	17.5	18.0	18.5	19.0	19.5	20.0	20.0	22.0	22.0	22.0	21.0	21.0	20.8	19.28
9	20.5	20.2	20.0	20.0	19.5	19.0	18.8	18.5	18.0	18.0	17.8	18.0	18.5	19.0	19.5	20.0	21.0	21.5	22.0	23.0	23.0	22.0	22.0	21.8	20.07
10	22.4	22.3	22.2	22.0	22.0	21.9	21.8	21.6	21.4	21.3	21.5	21.6	22.0	22.7	23.3	23.5	23.7	23.4	23.2	23.0	22.8	22.4	22.0	21.5	22.31
11	20.8	20.0	19.5	19.0	18.5	18.0	17.5	17.0	17.5	18.0	18.5	20.0	21.0	21.5	23.0	24.0	24.0	23.0	22.0	22.0	21.5	21.5	21.2	21.0	20.42
12	20.5	20.0	19.8	19.5	19.0	18.8	18.5	18.0	18.5	18.8	19.0	19.0	19.5	20.0	21.0	21.5	22.0	22.0	22.0	22.0	22.0	22.0	21.5	21.2	20.25
13	21.0	21.0	20.5	20.0	19.8	19.5	18.8	18.0	18.5	19.0	19.0	19.0	19.5	20.0	20.5	21.0	22.0	21.5	21.2	21.0	21.0	20.5	20.0	20.0	20.10
14	19.8	19.5	19.0	18.5	18.0	17.5	17.0	17.0	17.0	17.0	17.5	18.0	18.5	19.0	20.0	20.5	21.0	21.0	20.0	20.0	20.0	20.0	19.5	19.0	18.93
15	18.8	18.5	18.0	17.5	17.0	16.5	16.0	16.0	16.0	16.5	17.0	17.5	18.0	19.0	19.5	20.0	20.5	20.5	20.0	20.0	20.0	19.5	18.9	18.4	18.32
16	18.0	17.8	17.0	17.0	16.5	16.0	15.0	15.5	16.2	16.5	17.0	17.5	18.0	19.0	19.0	20.0	20.5	20.5	20.5	20.0	20.0	20.0	19.8	19.0	18.18
17	18.8	18.2	18.0	17.5	17.0	16.8	16.0	15.8	16.0	16.0	16.0	17.0	17.5	18.0	19.0	19.5	20.0	20.5	20.5	20.0	20.0	20.0	19.5	19.0	18.19
18	18.7	18.5	18.0	17.9	17.6	17.4	17.0	16.8	16.9	17.0	18.0	18.5	19.3	19.7	20.2	20.5	20.0	19.6	19.2	19.0	19.0	19.0	18.8	19.6	18.59
19	20.0	19.5	19.0	18.8	18.2	18.0	17.5	17.0	16.8	16.5	16.2	17.0	17.5	18.0	18.5	19.0	20.0	21.0	21.0	21.0	20.5	20.5	20.0	19.6	18.80
20	19.0	18.3	18.0	17.7	17.6	17.3	17.0	16.8	16.8	17.0	18.5	19.8	21.0	21.0	21.0	21.3	20.8	20.4	20.2	20.1	20.0	20.0	20.0	19.8	19.14
21	19.4	19.0	19.0	18.6	18.4	18.1	18.0	17.6	17.5	17.6	17.8	18.4	19.3	20.6	21.0	21.5	21.0	20.7	20.3	20.3	20.2	20.1	20.0	20.0	19.35
22	20.5	20.2	20.0	19.8	19.3	19.0	18.5	18.3	18.0	17.5	17.5	18.0	19.5	19.0	19.5	20.0	20.5	21.5	22.0	21.3	21.0	21.0	20.5	20.0	19.68
23	19.5	19.2	19.0	18.6	18.2	18.0	17.8	18.0	18.0	18.2	20.0	21.5	21.5	22.0	23.0	23.2	22.0	22.0	21.5	21.2	21.0	21.0	21.0	20.5	20.25
24	20.0	20.0	19.5	18.5	18.2	18.2	18.0	18.0	18.0	19.0	21.0	22.0	22.0	23.0	23.5	24.0	23.5	23.0	22.0	21.5	21.0	21.0	20.5	20.2	20.65
25	20.2	20.0	19.8	19.5	19.0	18.8	18.2	18.0	18.0	18.0	20.0	20.5	21.0	21.5	22.0	22.0	21.0	21.0	21.0	21.0	21.0	21.0	20.5	20.2	20.13
26	20.0	20.0	20.0	19.5	19.0	18.5	18.0	18.0	18.0	20.0	20.0	21.0	21.0	22.2	22.2	21.2	21.0	21.0	21.0	21.0	21.0	21.0	20.5	20.2	20.22
27	20.0	20.0	20.0	19.2	19.0	19.0	18.5	18.5	19.0	18.0	20.0	21.0	22.0	23.0	22.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	20.34
28	20.5	20.0	20.0	20.0	19.8	19.0	19.0	18.5	18.5	18.5	20.0	20.0	20.0	21.0	22.0	22.0	22.0	21.0	21.5	21.2	21.0	20.0	20.0	20.0	20.23
29	20.2	20.0	19.8	19.5	19.0	18.8	18.2	18.0	18.0	18.0	20.0	20.5	21.0	21.5	22.0	22.0	21.0	21.0	21.0	21.0	21.0	21.0	20.5	20.2	20.13
30	19.9	19.6	19.5	19.4	19.3	19.1	19.0	19.0	19.0	19.1	19.7	20.4	21.0	21.5	22.0	22.4	21.6	21.3	21.1	21.2	21.4	21.7	21.6	21.9	20.49
31	22.1	22.3	22.2	22.0	22.0	21.9	21.8	21.6	21.4	21.3	21.5	21.6	22.0	22.7	23.3	23.5	23.7	23.4	23.2	23.0	22.8	22.8	22.7	22.5	22.39

January 1993

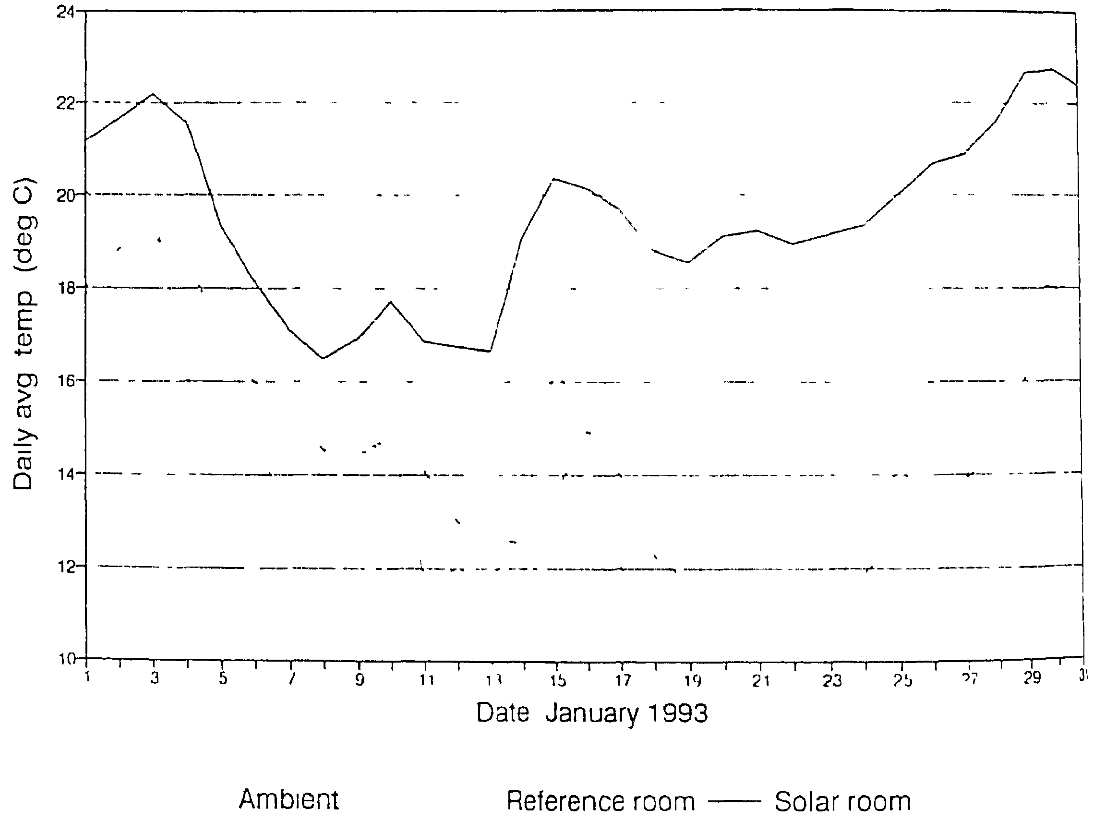

Figure: Comparative performance monitoring of solar chimney system for January 1993

Table: Hourly ambient temperature data for January 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	16.2	15.8	15.6	15.3	14.6	14.6	14.7	14.6	14.4	18.0	22.4	24.4	24.7	26.6	26.6	26.1	25.7	24.8	23.7	22.2	21.6	20.5	20.8	19.0	20.12
2	18.1	16.8	16.9	16.9	17.0	17.3	17.2	17.2	16.0	15.8	16.6	18.1	21.6	22.9	23.0	23.3	23.2	22.9	22.0	20.5	20.0	19.3	19.0	18.9	19.19
3	18.3	17.9	17.6	17.5	17.2	16.8	16.9	16.9	16.9	16.5	18.6	21.8	23.0	24.0	23.6	23.7	23.6	23.4	22.5	21.6	19.9	19.7	19.3	18.2	19.81
4	17.4	16.7	15.6	13.8	13.1	12.9	13.2	12.8	11.8	11.4	12.5	15.1	18.3	20.2	21.0	21.2	21.2	21.0	19.7	17.7	16.7	15.0	14.1	13.4	16.08
5	12.6	11.9	11.9	11.9	10.9	10.8	10.8	10.7	10.4	10.4	11.8	14.1	16.0	17.3	18.0	18.1	18.1	17.8	17.3	16.6	16.2	15.5	15.3	15.4	14.16
6	14.8	14.0	13.8	13.8	13.8	13.8	13.6	13.6	13.7	13.8	14.3	14.5	15.7	16.0	16.8	16.7	16.5	16.3	16.2	15.8	15.7	15.1	14.7	14.1	14.88
7	13.3	13.0	12.6	12.2	11.6	10.8	8.4	8.7	10.8	13.1	13.6	13.8	14.9	15.0	14.6	14.6	14.8	14.8	14.3	13.7	13.1	12.9	12.6	12.3	12.90
8	11.8	11.8	11.9	11.9	11.8	11.6	10.9	8.4	8.2	7.8	9.1	10.6	13.0	15.7	17.5	18.4	18.3	17.9	17.6	15.9	14.8	14.3	13.8	13.0	13.17
9	12.1	11.9	11.9	11.9	11.8	11.8	11.8	11.7	11.7	11.4	11.8	12.6	14.8	16.7	17.9	18.5	18.1	18.6	17.9	16.7	16.0	15.5	15.0	14.5	14.28
10	13.6	13.1	12.8	12.1	11.6	11.4	11.4	11.3	11.3	11.9	12.8	14.7	16.9	17.8	18.5	19.4	19.4	19.1	18.6	17.8	16.9	15.5	14.9	13.9	14.86
11	13.1	12.2	11.9	11.5	10.5	9.9	9.5	8.9	8.9	8.0	10.1	10.9	11.7	12.1	12.9	13.5	13.9	13.7	13.3	13.2	13.1	13.1	12.7	12.5	11.71
12	11.5	10.8	10.6	10.6	9.6	9.1	8.1	8.6	7.7	8.2	10.9	12.3	13.8	15.1	16.1	16.8	16.7	16.4	16.6	13.8	12.1	11.1	10.6	10.1	12.00
13	10.8	9.2	8.3	8.2	7.8	7.6	6.6	6.2	5.7	7.1	10.8	14.1	15.8	17.3	18.1	18.5	13.6	18.3	16.1	14.6	12.6	11.7	11.8	10.6	11.73
14	9.8	9.6	9.6	9.2	8.1	7.4	7.2	6.8	6.9	8.8	12.4	14.6	16.6	18.8	19.4	20.1	20.1	19.7	18.2	15.8	14.7	13.6	12.4	12.6	13.02
15	12.5	11.8	11.8	12.1	17.5	12.1	11.3	11.0	11.0	12.3	14.2	17.1	19.2	20.5	21.8	22.1	22.2	22.0	20.1	18.3	18.1	17.5	17.4	17.4	16.30
16	17.1	17.3	17.0	16.6	16.0	15.7	15.6	15.4	15.0	11.2	13.0	11.4	14.0	14.4	15.6	15.9	15.8	15.7	15.6	15.4	15.1	14.2	13.7	13.6	15.18
17	12.9	11.5	10.4	10.4	10.1	9.8	9.4	8.8	8.1	8.1	10.2	11.1	14.1	15.3	16.3	16.8	17.1	16.8	15.8	13.1	12.2	11.0	9.6	8.3	12.01
18	7.7	6.8	6.6	6.4	6.1	5.4	5.2	4.9	4.8	7.0	10.9	13.4	15.6	15.7	16.6	16.8	17.1	16.6	15.5	13.8	12.2	11.1	10.3	9.6	10.67
19	8.8	8.2	7.4	7.5	6.7	6.7	5.8	5.1	5.1	5.8	9.4	11.7	14.9	15.8	16.6	17.4	17.4	17.2	16.6	15.1	13.9	12.3	10.4	9.4	11.14
20	8.0	8.1	7.4	7.4	6.8	5.9	5.5	5.4	5.1	7.0	9.8	13.0	15.2	17.1	18.1	18.6	18.5	18.3	17.0	14.7	14.1	13.2	12.9	10.8	11.58
21	9.7	8.2	7.9	7.5	6.9	6.6	5.6	4.6	4.9	7.4	10.1	12.6	14.0	16.0	16.7	17.1	16.9	16.8	15.7	14.6	13.5	11.5	10.6	10.4	11.08
22	8.4	7.7	6.6	6.4	5.6	4.9	4.6	4.3	4.0	6.6	11.2	13.7	15.6	17.0	17.5	18.0	17.8	17.7	17.0	14.3	12.3	11.5	10.8	9.1	10.94
23	7.6	7.5	7.2	6.2	5.6	5.3	4.6	4.3	4.3	5.8	10.4	13.3	15.5	17.1	18.3	18.7	18.8	18.4	17.8	15.0	13.5	12.5	10.8	9.9	11.18
24	8.8	8.1	8.5	7.7	6.8	6.7	6.0	5.0	5.1	8.0	11.1	15.0	17.8	19.2	20.0	20.4	20.7	20.3	19.3	17.9	16.6	15.5	14.4	12.7	12.98
25	12.9	12.7	12.6	10.9	9.6	8.0	6.7	6.5	6.2	9.1	12.9	15.3	17.8	19.5	21.6	21.7	21.8	21.3	20.3	18.7	15.8	13.8	12.8	12.1	14.19
26	11.5	11.0	10.5	9.1	8.8	7.7	6.9	6.3	6.4	7.3	11.5	14.7	16.0	18.6	19.7	20.0	20.3	20.0	18.6	15.9	13.4	12.4	11.7	11.7	12.92
27	11.0	11.3	10.0	8.0	7.2	6.8	6.0	5.8	5.5	8.6	13.0	17.0	20.0	20.2	21.3	22.1	22.3	22.2	20.6	17.5	15.8	15.6	13.8	13.5	13.96
28	12.8	12.6	12.0	11.8	11.3	11.2	11.2	11.3	11.3	13.7	16.1	20.3	21.0	23.1	23.3	23.7	23.7	22.8	21.1	16.7	19.6	18.6	18.2	18.2	16.90
29	17.1	16.8	16.0	15.9	14.7	14.7	14.7	14.2	14.1	14.7	17.1	19.6	21.1	21.8	22.7	23.4	23.3	22.8	21.3	19.7	18.3	17.5	17.0	16.4	18.12
30	16.1	15.6	14.8	14.5	14.0	13.1	12.3	12.0	11.9	14.5	18.0	20.7	22.3	23.1	23.7	23.9	23.7	23.6	21.6	19.8	18.7	18.6	18.2	17.5	18.01
31	16.3	15.4	14.7	13.5	13.1	12.6	11.8	11.2	10.9	12.8	15.1	18.6	20.9	22.0	22.9	23.7	23.8	23.3	22.7	20.9	19.8	18.9	16.8	15.5	17.38

Table: Hourly reference conventional room temperature data for January 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	17.8	17.7	17.6	17.5	17.4	17.3	17.2	17.0	17.0	17.0	17.0	17.3	17.5	18.0	18.5	19.0	19.0	19.0	19.0	18.8	18.8	18.9	18.9	18.9	18.00
2	18.9	18.9	18.3	18.8	18.7	18.6	18.5	18.4	18.4	19.3	18.3	18.5	18.6	18.9	19.0	19.1	19.3	19.2	19.1	19.1	19.1	19.1	19.1	19.0	18.84
3	19.0	19.0	19.0	19.0	19.0	18.9	18.8	18.7	18.6	18.6	18.7	18.7	18.8	19.0	19.3	19.4	19.6	19.7	19.6	19.5	19.5	19.5	19.4	19.4	19.11
4	19.3	19.2	19.1	19.0	19.0	18.9	18.8	18.6	18.5	18.4	18.2	18.2	18.2	18.4	18.6	18.7	18.7	18.7	18.7	18.6	18.5	18.4	18.3	18.3	18.64
5	18.1	18.0	17.8	17.7	17.5	17.3	17.1	17.0	16.8	16.7	16.6	16.4	16.4	16.4	16.5	16.7	16.8	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.95
6	16.5	16.5	16.4	16.2	16.1	16.0	15.9	15.7	15.4	15.3	15.3	15.4	15.5	15.5	16.0	16.0	16.0	16.1	16.2	16.3	16.3	16.3	16.3	16.3	15.98
7	16.0	16.0	16.0	15.9	15.8	15.7	15.5	15.4	15.3	15.3	15.2	15.2	15.2	15.2	15.2	15.3	15.3	15.3	15.2	15.2	15.2	15.1	15.0	15.0	15.40
8	15.0	15.0	14.9	14.8	14.8	14.7	14.5	14.4	14.3	14.2	14.1	14.0	14.0	14.3	14.5	14.7	14.7	14.7	14.7	14.6	14.5	14.5	14.4	14.3	14.53
9	14.3	14.2	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	13.9	14.0	14.5	14.8	14.8	14.8	14.8	14.9	14.9	14.9	14.9	15.0	15.0	14.40
10	15.0	15.0	14.9	14.8	14.7	14.6	14.5	14.4	14.3	14.3	14.4	14.5	14.7	15.0	15.1	15.1	15.1	15.2	15.2	15.2	15.2	15.2	15.2	15.1	14.86
11	15.1	15.0	15.0	15.0	15.0	14.8	14.6	14.5	14.3	14.2	14.1	14.0	14.0	14.0	14.0	13.5	13.6	13.5	13.5	13.4	13.4	13.4	13.3	13.3	14.10
12	13.2	13.2	13.0	13.0	13.0	13.0	12.8	12.8	12.6	12.6	12.6	12.6	12.7	13.0	13.4	13.3	13.2	13.2	13.1	13.1	13.1	13.1	13.0	13.0	12.98
13	13.0	13.0	12.8	12.8	12.7	12.5	12.3	12.2	12.0	12.0	12.0	12.0	12.2	12.4	12.8	13.0	13.0	13.1	13.0	13.0	13.0	13.0	13.0	13.0	12.66
14	13.0	12.9	12.8	12.6	12.4	12.3	12.0	11.9	11.8	11.8	11.8	11.9	12.0	12.4	12.7	12.7	12.7	12.7	12.8	13.0	13.0	13.0	13.0	13.0	12.51
15	13.0	13.0	13.0	13.0	13.0	13.0	12.9	12.8	12.8	12.8	13.0	13.2	13.2	13.4	14.0	14.0	14.0	14.2	14.3	14.4	14.5	14.7	14.8	14.8	13.58
16	14.8	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	14.95
17	14.9	14.8	14.7	14.6	14.4	14.3	14.0	14.0	13.8	13.8	13.7	13.7	13.8	14.0	14.1	14.0	14.0	13.9	13.8	13.7	13.6	13.6	13.5	13.4	14.00
18	13.2	13.0	13.0	12.8	12.5	12.3	12.0	12.0	11.8	11.8	11.7	11.7	11.8	12.0	12.4	12.3	12.3	12.3	12.3	12.3	12.3	12.2	12.2	12.2	12.27
19	12.1	12.0	12.0	11.9	11.8	11.6	11.4	11.2	11.0	11.0	11.0	11.0	11.2	11.5	11.9	11.9	12.0	12.0	12.0	12.0	12.0	12.0	2.0	12.0	11.69
20	12.0	12.0	11.9	11.8	11.6	11.4	11.3	11.2	11.0	11.0	11.0	11.0	11.8	11.9	12.0	12.0	12.0	12.0	12.0	12.1	12.2	12.2	12.2	12.2	11.74
21	12.1	12.0	12.0	12.0	11.9	11.7	11.6	11.4	11.3	11.2	11.2	11.2	11.3	11.6	11.9	11.8	11.8	11.9	11.9	11.9	11.9	11.9	12.0	11.9	11.73
22	11.8	11.8	11.7	11.8	11.4	11.2	11.0	11.0	10.8	10.8	10.8	10.9	11.0	11.4	11.8	11.8	11.8	11.8	11.8	11.8	11.9	11.9	11.9	11.9	11.48
23	11.9	11.8	11.7	11.5	11.4	11.2	11.0	11.0	10.8	10.8	10.8	10.8	11.0	11.2	11.8	11.8	11.7	11.8	12.0	12.0	12.0	12.0	12.0	12.0	11.49
24	12.0	12.0	12.0	11.9	11.5	11.4	11.3	11.1	11.1	11.1	11.2	11.3	11.4	11.5	12.0	12.2	12.2	12.4	12.4	12.5	12.6	12.7	12.8	12.8	11.89
25	12.8	12.8	12.8	12.6	12.4	12.3	12.1	12.0	11.8	11.8	11.9	12.0	12.0	12.3	12.7	13.0	13.0	13.0	13.2	13.3	13.4	13.5	13.6	13.7	12.67
26	13.8	13.8	13.8	13.6	13.4	13.3	13.1	13.0	12.9	12.8	12.8	12.8	13.0	13.0	13.5	13.8	13.8	13.8	13.9	13.9	14.0	14.0	14.0	14.0	13.49
27	14.0	14.0	14.0	13.8	13.7	13.6	13.4	13.3	13.2	13.0	13.0	13.0	13.2	13.9	14.2	14.3	14.3	14.4	14.6	14.6	14.7	14.8	14.8	14.8	13.94
28	14.8	14.7	14.6	14.4	14.3	14.0	14.0	13.8	13.7	13.6	13.6	13.7	13.8	14.0	14.6	14.8	14.8	14.8	14.9	15.0	15.0	15.2	15.3	15.4	14.45
29	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.7	15.9	16.1	16.4	16.6	16.8	17.0	17.0	17.2	17.2	17.2	17.2	17.2	17.2	16.24
30	17.2	17.2	17.1	17.0	17.0	16.9	16.7	16.5	16.4	16.4	16.4	16.4	16.5	16.6	16.8	17.0	17.0	17.0	17.0	17.0	17.1	17.1	17.1	17.1	16.85
31	17.1	17.0	17.0	17.0	16.8	16.7	16.6	16.5	16.4	16.2	16.2	16.2	16.2	16.2	16.6	16.7	16.8	16.8	16.9	16.9	17.0	17.0	17.0	17.0	16.70

Table: Hourly solar chimney room temperature data for January 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	21.6	21.3	21.0	20.9	20.5	20.2	20.0	19.8	19.6	19.5	19.5	20.8	21.8	21.8	22.0	22.9	22.5	22.0	21.8	21.8	21.8	21.7	21.7	21.6	21.17
2	21.4	21.3	21.2	21.0	21.0	20.8	20.6	20.4	20.2	20.1	20.0	20.8	21.8	22.7	22.9	23.3	23.4	23.0	22.5	22.4	22.3	22.3	22.2	22.1	21.65
3	22.0	21.9	21.8	21.6	21.4	21.2	21.0	21.0	20.8	20.7	20.6	20.7	22.0	23.0	23.6	24.0	24.2	23.6	23.2	23.0	23.0	22.9	22.8	22.6	22.19
4	22.4	22.2	22.0	21.8	21.6	21.4	21.0	20.8	20.7	20.4	20.2	20.2	21.2	21.5	22.0	22.5	23.0	22.5	22.2	21.9	21.8	21.7	21.5	21.4	21.58
5	21.2	21.0	20.7	20.4	20.0	19.9	19.6	19.3	19.0	18.8	18.7	18.5	18.7	18.8	19.0	19.2	19.2	19.0	18.9	18.9	18.9	18.9	18.9	18.8	19.35
6	18.7	18.6	18.5	18.4	18.3	18.2	18.1	18.0	17.9	17.8	17.8	17.8	17.9	18.1	18.6	18.3	18.2	18.1	18.0	18.0	18.0	18.0	18.0	18.0	18.14
7	17.9	17.8	17.7	17.6	17.4	17.2	17.0	17.0	16.9	16.8	16.8	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	16.9	16.9	16.8	17.11
8	16.8	16.6	16.5	16.5	16.4	16.3	16.1	16.0	15.9	15.8	15.7	15.7	15.8	16.0	17.2	17.5	17.1	17.0	17.0	16.9	16.9	16.9	16.8	16.7	16.50
9	16.7	16.6	16.4	16.2	16.1	16.0	16.0	15.9	15.8	15.8	15.8	15.8	16.5	17.5	18.4	18.7	18.0	17.7	17.7	17.7	17.7	17.7	17.7	17.6	16.92
10	17.5	17.4	17.3	17.2	17.1	17.0	16.9	16.8	16.6	16.6	16.5	17.0	17.5	18.5	19.0	19.2	19.0	18.6	18.5	18.4	18.4	18.4	18.3	18.2	17.75
11	18.1	18.0	17.9	17.8	17.5	17.3	17.0	16.9	16.7	16.5	16.4	16.5	16.4	16.8	16.5	16.6	17.0	16.6	16.5	16.5	16.3	16.3	16.3	16.3	16.86
12	16.2	16.1	16.0	16.0	15.8	15.5	15.4	15.3	15.1	15.0	15.0	16.0	17.5	18.6	18.5	18.6	18.6	18.5	17.9	17.6	17.4	17.3	17.1	17.0	16.75
13	17.0	16.8	16.7	16.5	16.2	16.0	15.7	15.4	15.2	15.0	15.0	15.2	16.0	16.5	17.0	18.5	18.0	17.7	17.7	17.6	17.6	17.6	17.5	17.6	16.67
14	17.6	17.6	17.6	17.4	17.2	17.1	17.0	17.0	17.0	17.7	18.0	19.5	20.0	21.0	21.4	22.0	21.3	20.5	20.4	20.3	20.2	20.1	20.0	20.0	19.08
15	19.9	19.6	19.5	19.4	19.3	19.1	19.0	19.0	19.0	19.1	19.7	20.4	21.0	21.5	22.0	22.4	21.6	21.3	21.1	21.2	21.0	21.0	21.0	21.0	20.38
16	20.9	20.8	20.7	20.5	20.4	20.3	20.2	20.2	20.1	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	19.9	19.8	20.16
17	19.6	19.5	19.3	19.1	19.0	18.7	18.5	18.4	18.2	18.2	18.8	20.4	21.1	21.5	21.5	21.5	20.8	20.3	20.0	20.0	20.0	19.8	19.8	19.4	19.73
18	19.0	18.9	18.6	18.3	18.0	17.6	17.4	17.2	17.2	17.3	18.3	18.8	19.5	19.8	20.2	20.5	20.0	19.7	19.6	19.5	19.4	19.3	19.0	18.8	18.83
19	18.7	18.5	18.0	17.9	17.6	17.4	17.0	16.8	16.9	17.0	18.0	18.5	19.3	19.7	20.2	20.5	20.0	19.6	19.2	19.0	19.0	19.0	18.8	18.6	18.55
20	18.5	18.3	18.0	17.7	17.6	17.3	17.0	16.8	16.8	17.0	18.5	19.8	21.0	21.0	21.0	21.3	20.8	20.4	20.2	20.1	20.0	20.0	20.0	19.8	19.12
21	19.6	19.4	19.1	18.9	18.8	18.5	18.1	18.0	17.9	18.0	18.7	19.6	19.9	20.8	20.6	20.3	20.0	19.8	19.6	19.5	19.4	19.3	19.2	19.0	19.25
22	19.0	18.7	18.4	18.2	18.0	17.9	17.5	17.3	17.2	17.4	18.4	18.6	19.0	20.0	20.2	20.8	20.6	20.0	19.8	19.8	19.8	19.7	19.5	19.2	18.96
23	19.0	18.8	18.6	18.3	18.0	17.7	17.5	17.2	17.2	17.3	18.0	18.5	19.3	20.5	21.0	21.4	21.6	20.6	20.0	20.0	20.0	19.9	19.8	19.6	19.16
24	19.4	19.0	19.0	18.6	18.4	18.1	18.0	17.6	17.5	17.6	17.8	18.4	19.3	20.6	21.0	21.5	21.0	20.7	20.3	20.3	20.2	20.1	20.0	20.0	19.35
25	20.0	19.6	19.4	19.0	19.0	18.6	18.4	18.1	18.0	18.1	18.2	19.0	20.0	20.7	21.9	22.2	22.2	21.6	21.3	21.2	21.1	21.1	21.0	21.0	20.03
26	20.8	20.6	20.3	20.0	20.0	19.7	19.4	19.0	19.0	19.0	19.0	19.5	21.0	21.8	22.5	22.8	22.6	22.0	21.5	21.4	21.3	21.2	21.0	21.0	20.68
27	20.8	20.6	20.3	20.0	20.0	19.8	19.5	19.1	19.0	19.0	19.2	20.3	21.4	22.0	22.3	22.7	23.2	22.5	22.2	21.8	21.7	21.6	21.5	21.3	20.91
28	21.2	21.0	20.8	20.6	20.4	20.0	20.0	19.8	19.7	19.6	19.7	20.0	22.5	24.0	24.6	24.6	25.0	23.5	22.3	22.0	21.9	21.8	21.8	21.8	21.61
29	21.7	21.6	21.6	21.5	21.4	21.4	21.3	21.2	21.2	21.3	21.5	22.7	24.2	24.5	24.8	24.8	24.8	24.4	23.5	23.2	23.0	23.0	22.9	22.8	22.68
30	22.7	22.6	22.4	22.3	22.2	22.0	21.8	21.7	21.6	21.5	21.6	23.0	24.2	24.5	24.5	24.7	23.5	23.0	22.8	22.8	22.8	22.7	22.6	22.5	22.75
31	22.4	22.3	22.2	22.0	22.0	21.9	21.8	21.6	21.4	21.3	21.5	21.6	22.0	22.7	23.3	23.5	23.7	23.4	23.2	23.0	22.8	22.8	22.7	22.5	22.40

February 1993

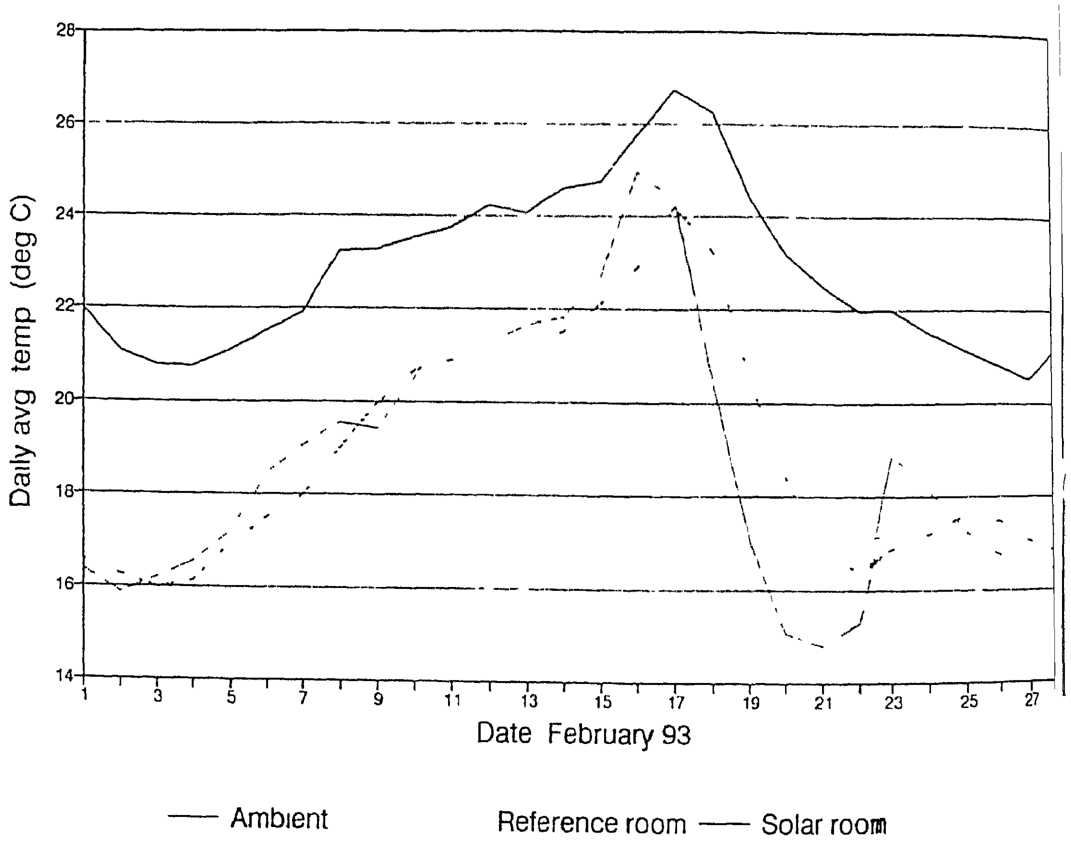

Figure: Comparative performance monitoring of solar chimney system for February 1993

Table: Hourly ambient temperature data for February 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	14.8	14.0	13.8	12.5	12.0	11.6	11.1	10.8	10.8	11.1	14.1	17.2	19.5	22.0	22.3	22.6	22.6	22.2	21.5	20.3	17.5	16.7	16.9	14.6	16.35
2	13.7	12.8	12.2	12.6	11.3	10.5	9.8	9.4	9.4	11.6	14.8	17.7	19.9	21.1	22.2	22.3	22.5	22.3	21.4	19.1	17.7	16.3	15.4	14.6	15.86
3	13.6	12.6	12.3	11.8	11.7	11.2	10.2	10.2	10.0	11.7	15.1	17.9	20.5	21.9	22.3	22.6	22.5	22.4	21.8	19.9	17.9	16.7	16.4	15.4	16.19
4	14.8	13.2	12.5	11.8	10.9	10.4	10.2	10.1	9.8	11.1	14.7	17.7	20.9	22.7	23.8	24.2	24.1	23.6	23.2	20.7	18.4	17.2	15.7	15.4	16.55
5	14.9	14.3	13.5	12.8	12.4	12.1	11.0	10.7	10.4	11.8	14.2	17.3	20.0	22.2	24.4	25.3	25.2	25.1	23.7	20.9	18.7	17.9	17.7	16.3	17.20
6	15.6	15.4	14.5	14.0	13.3	12.8	11.9	11.2	11.1	12.6	15.7	19.9	22.6	23.8	25.4	25.9	25.9	25.6	25.0	23.2	20.9	18.9	18.7	18.7	18.44
7	18.4	16.2	15.0	14.2	13.7	12.4	12.2	12.1	19.9	14.0	16.2	19.6	22.3	23.1	25.3	26.0	26.4	26.4	24.9	22.4	20.6	19.4	18.4	17.9	19.04
8	17.1	16.6	16.9	15.2	14.8	14.2	13.5	12.9	12.9	14.0	17.7	20.0	22.2	24.5	26.0	27.1	27.1	26.8	25.7	23.4	21.4	21.4	19.8	18.2	19.56
9	15.7	16.6	15.2	15.4	14.8	13.1	12.8	11.9	11.8	13.0	16.6	19.8	22.8	24.8	27.6	28.1	27.5	26.9	25.8	24.0	22.1	21.3	19.9	18.8	19.43
10	16.0	17.9	17.0	16.7	16.2	15.6	14.9	14.9	14.7	14.8	18.4	18.8	25.6	27.0	27.5	27.9	27.4	26.9	25.2	23.4	22.5	21.5	21.0	20.3	20.50
11	20.3	19.0	18.5	18.2	17.8	17.8	17.4	17.2	17.3	19.5	21.0	22.7	24.5	26.0	27.3	27.3	27.3	27.3	26.5	24.6	22.8	22.1	21.2	19.9	21.81
12	19.4	13.7	18.7	18.3	17.6	16.7	16.7	16.5	16.3	14.7	18.0	22.4	25.6	27.1	27.3	28.1	28.5	28.3	27.7	24.6	22.7	22.1	21.0	18.6	21.28
13	18.2	18.3	16.7	16.2	15.6	14.8	14.2	14.6	13.9	16.8	21.0	24.0	26.0	28.0	29.8	30.1	30.0	29.9	28.5	25.6	24.6	22.6	22.0	18.7	21.67
14	18.0	17.3	17.0	16.6	15.5	14.6	13.9	13.5	13.3	16.7	22.0	25.7	27.8	28.9	30.0	30.3	30.4	30.1	29.1	25.6	24.3	22.2	20.5	20.0	21.80
15	18.5	19.1	18.0	16.7	16.6	16.0	16.0	16.0	16.0	19.5	23.8	25.7	27.8	29.3	29.6	30.0	29.8	29.8	29.1	25.6	24.3	23.4	22.4	22.0	22.71
16	21.5	20.7	19.8	19.1	18.7	18.6	18.2	17.9	18.0	23.0	25.1	27.2	29.0	30.7	31.2	32.4	32.4	32.9	32.0	27.9	26.7	26.2	25.4	24.3	24.95
17	23.3	22.2	21.7	22.2	21.8	21.1	19.5	18.1	18.6	20.9	22.6	25.5	27.0	28.6	29.5	30.4	30.0	30.0	29.0	26.4	25.7	24.8	22.9	22.6	24.35
18	21.4	21.4	20.6	17.9	16.6	15.4	14.4	13.9	13.7	15.6	18.6	21.6	25.2	27.8	27.0	27.2	27.0	26.7	24.4	22.0	20.1	18.7	17.2	16.0	20.43
19	15.7	14.6	14.0	13.6	13.1	12.4	12.0	12.0	12.1	15.3	16.3	18.1	20.1	21.2	22.2	22.8	22.9	23.0	22.1	20.7	17.8	17.4	15.8	14.7	17.08
20	13.2	12.1	11.3	10.1	9.8	9.1	8.2	8.0	8.0	10.4	14.3	17.7	19.4	21.0	21.0	21.4	21.4	21.2	20.5	19.3	18.2	17.0	15.0	13.6	15.05
21	12.8	11.8	9.9	8.9	8.8	8.6	8.0	7.9	8.9	12.2	18.7	19.0	19.7	20.0	20.4	21.2	21.0	20.9	20.2	18.7	17.7	16.2	14.5	12.3	14.78
22	11.3	10.5	10.0	9.5	8.8	8.3	8.4	7.5	7.3	10.6	14.7	13.1	20.3	21.4	21.6	22.2	22.5	22.4	21.8	20.2	19.7	19.1	18.1	17.3	15.28
23	16.6	16.6	16.6	16.1	15.4	15.3	15.2	15.2	15.2	17.0	19.0	20.9	22.2	23.0	23.2	23.3	23.2	22.7	22.2	20.3	19.1	18.6	18.5	18.0	18.89
24	17.4	17.2	17.1	16.3	16.2	16.1	15.6	15.2	16.8	18.5	19.3	21.4	21.0	21.0	21.0	21.0	21.0	19.3	18.1	17.6	17.2	17.0	17.0	16.9	18.13
25	16.0	16.0	16.0	16.0	16.0	16.1	16.2	16.3	16.1	15.3	15.5	16.0	17.4	18.7	18.9	19.7	19.9	19.7	19.1	18.6	18.1	17.7	17.3	16.9	17.23
26	16.3	16.3	16.1	15.6	15.6	15.6	15.0	15.1	15.2	15.9	16.6	16.9	17.1	17.5	17.9	18.1	18.2	18.3	18.0	17.7	17.7	17.6	17.1	16.5	16.75
27	15.3	15.2	15.1	15.0	14.8	14.8	14.5	14.2	14.6	13.6	14.2	14.6	16.1	16.3	16.6	17.5	18.2	18.2	18.3	17.8	17.0	16.2	15.6	15.3	15.79
28	14.6	14.2	14.0	13.2	13.2	12.7	12.7	12.7	12.7	13.5	13.5	13.9	16.9	19.0	19.9	21.3	21.8	21.5	20.8	20.6	19.9	18.6	17.9	17.0	16.50

Table: Hourly reference conventional room temperature data for February 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	17.0	17.0	16.9	16.8	16.6	16.5	16.3	16.2	16.0	16.0	16.0	16.0	16.0	16.2	16.5	16.7	16.7	16.8	16.8	16.8	16.9	16.9	16.9	16.9	16.56
2	16.9	16.9	16.7	16.6	16.4	16.2	16.0	16.0	15.7	15.6	15.6	15.6	15.7	15.7	16.2	16.4	16.4	16.4	16.5	16.5	16.5	16.5	16.5	16.5	16.25
3	16.5	16.5	16.4	16.2	16.1	16.0	15.9	15.7	15.4	15.3	15.3	15.4	15.5	15.5	16.0	16.0	16.0	16.1	16.2	16.3	16.3	16.3	16.3	16.3	15.98
4	16.3	16.3	16.2	16.0	16.0	15.9	15.7	15.6	15.4	15.3	15.3	15.5	15.6	15.7	16.3	16.4	16.4	16.5	16.5	16.6	16.7	16.8	16.9	16.9	16.12
5	16.9	16.9	16.9	16.8	16.6	16.5	16.4	16.2	16.0	16.0	16.0	16.3	16.3	16.4	17.0	17.5	17.7	18.0	17.7	17.7	17.7	17.7	17.7	17.7	16.94
6	17.7	17.7	17.6	17.5	17.4	17.3	17.1	17.0	16.8	16.8	16.8	17.0	17.2	17.0	17.6	17.8	17.8	17.8	18.0	18.0	18.0	18.0	18.0	18.0	17.50
7	18.0	18.0	18.0	17.9	17.7	17.5	17.4	17.3	17.2	17.1	17.1	17.4	17.5	17.6	18.0	18.4	18.3	18.5	18.6	18.6	18.7	18.8	18.9	18.9	17.98
8	18.9	18.9	18.9	18.8	18.7	18.6	18.4	18.3	18.2	18.2	18.2	18.3	18.4	18.5	19.0	19.4	19.4	19.5	19.7	19.7	19.8	19.9	20.0	20.0	18.99
9	20.0	20.0	20.0	19.8	19.7	19.6	19.4	19.2	19.0	19.0	19.0	19.5	19.8	20.0	20.2	21.0	20.8	20.6	20.5	20.4	20.4	20.3	20.3	20.3	19.95
10	21.0	20.9	20.9	20.6	20.4	20.2	20.0	20.0	20.0	20.0	20.1	20.3	20.3	20.3	20.5	21.0	21.1	21.1	21.1	21.1	21.1	21.2	21.2	21.3	20.85
11	21.3	21.2	21.0	20.7	20.4	20.1	20.0	19.7	19.9	20.0	20.2	20.2	20.4	20.5	20.7	21.5	22.0	22.2	21.9	21.7	21.6	21.5	21.5	21.5	20.90
12	21.3	21.2	21.0	20.7	20.4	20.1	20.0	19.7	19.9	20.0	20.2	20.2	20.4	20.5	20.7	21.5	22.0	22.2	21.9	21.7	21.6	21.5	21.5	21.5	20.90
13	21.4	21.4	21.3	21.2	21.0	21.0	20.8	20.7	20.4	20.4	20.4	20.6	20.7	20.7	21.1	21.6	21.8	21.8	21.8	21.8	21.8	21.8	21.9	21.9	21.22
14	21.9	21.9	21.8	21.6	21.4	21.2	21.0	20.9	20.8	20.7	20.7	20.8	21.0	21.0	21.3	22.0	22.0	22.0	22.0	22.0	22.0	22.1	22.1	22.2	21.52
15	22.2	22.1	22.0	22.0	21.9	21.7	21.6	21.4	21.2	21.1	21.2	21.3	21.8	21.9	22.0	22.5	22.9	22.7	22.8	22.8	22.8	22.8	22.8	22.8	22.10
16	22.8	22.8	22.8	22.6	22.5	22.3	22.1	22.0	22.0	21.9	22.0	22.0	22.6	22.6	22.7	23.1	23.7	23.7	23.7	23.7	23.8	23.9	24.0	24.0	22.89
17	24.0	24.0	24.0	24.0	24.0	24.0	23.8	23.7	23.5	23.5	23.5	23.6	23.8	24.3	24.7	25.0	25.0	24.9	24.8	24.7	24.7	24.7	24.7	24.6	24.23
18	24.5	24.4	24.2	24.0	23.8	23.6	23.4	23.3	23.0	23.0	22.8	22.8	22.8	22.8	23.0	23.4	23.2	23.0	23.0	22.9	22.8	22.8	22.7	22.5	23.24
19	22.3	22.0	21.5	21.2	21.0	20.7	20.5	20.3	20.2	20.2	20.1	20.0	20.0	20.0	20.3	21.0	20.6	20.6	20.4	20.1	20.0	20.0	20.0	20.0	20.54
20	19.8	19.6	19.4	19.0	18.9	18.6	18.4	18.0	18.0	18.0	18.0	18.0	18.0	17.8	18.1	18.6	18.5	18.3	18.2	18.1	18.0	18.0	18.0	17.9	18.38
21	17.8	17.6	17.4	17.2	17.0	16.8	16.5	16.3	16.1	16.1	16.1	16.2	16.2	16.2	16.6	17.2	17.1	17.1	17.0	17.0	17.0	17.0	17.0	16.9	16.81
22	16.9	16.8	16.6	16.5	16.3	16.1	16.0	15.8	15.6	15.7	15.7	15.8	16.0	16.0	16.2	17.0	17.0	16.8	16.8	16.7	16.7	16.7	16.8	16.8	16.39
23	16.8	16.8	16.8	16.8	16.8	16.8	16.8	16.7	16.6	16.5	16.5	17.0	17.0	17.0	17.2	17.6	18.0	16.8	16.8	16.8	16.8	16.7	16.7	16.7	16.88
24	16.7	16.7	16.6	16.5	16.5	16.4	16.4	16.3	16.3	16.4	16.6	16.8	16.9	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	17.9	17.9	17.9	17.20
25	17.8	17.8	17.7	17.6	17.5	17.4	17.3	17.2	17.2	17.2	17.2	17.2	17.3	17.5	18.0	18.1	18.0	18.0	18.0	17.9	17.8	17.8	17.8	17.8	17.63
26	17.8	17.8	17.7	17.6	17.5	17.4	17.4	17.4	17.3	17.3	17.3	17.3	17.3	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.4	17.4	17.48
27	17.3	17.3	17.2	17.2	17.1	17.0	17.0	17.0	17.0	17.0	17.0	16.9	16.9	16.9	16.9	17.0	17.0	17.1	17.0	17.0	17.0	17.0	17.0	17.0	17.03
28	17.0	16.9	16.8	16.8	16.7	16.6	16.5	16.4	16.3	16.3	16.3	16.4	16.5	16.7	17.0	17.3	17.3	17.2	17.2	17.2	17.1	17.1	17.1	17.1	16.83

Table: Hourly solar chimney room temperature data for February 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	22.4	22.2	22.0	22.0	21.8	21.7	21.6	21.4	21.2	21.2	21.3	22.5	24.2	24.5	23.5	23.0	22.0	21.7	21.6	21.4	21.2	21.0	21.0	20.8	21.97
2	20.6	20.4	20.2	20.0	20.0	19.8	19.6	19.5	19.7	20.0	22.0	22.5	22.6	22.7	23.0	23.2	22.5	21.7	21.4	21.3	21.0	21.0	20.8	20.6	21.09
3	20.4	20.3	20.0	20.0	20.0	19.6	19.4	19.3	19.4	19.6	21.3	22.4	22.4	22.3	22.3	22.2	22.1	21.5	21.1	21.0	20.8	20.7	20.6	20.4	20.80
4	20.3	20.1	20.0	20.0	19.8	19.7	19.5	19.3	19.0	19.2	19.3	21.0	21.3	22.2	22.5	23.0	23.0	22.0	21.6	21.4	21.2	21.0	21.0	20.8	20.76
5	20.7	20.6	20.4	20.2	20.0	20.0	19.8	19.7	19.7	19.7	19.8	20.7	21.6	23.0	23.1	23.2	23.5	22.5	21.8	21.6	21.4	21.2	21.1	21.0	21.10
6	21.0	21.0	20.8	20.7	20.5	20.3	20.2	20.0	20.0	20.0	20.2	22.3	22.5	23.0	23.5	24.0	23.4	22.5	22.3	22.0	21.8	21.7	21.6	21.4	21.53
7	21.3	21.1	21.0	20.8	20.7	20.6	20.4	20.2	20.1	20.0	20.1	21.5	22.4	23.0	24.0	24.6	24.3	24.0	23.1	22.8	22.4	22.3	22.3	22.2	21.88
8	22.0	22.0	22.0	21.8	21.8	21.7	21.5	21.3	21.3	21.6	21.8	23.0	24.1	24.5	25.8	26.5	27.1	25.8	24.4	24.0	23.6	23.5	23.3	23.2	23.23
9	23.0	23.0	22.8	22.8	22.6	22.3	22.1	22.0	21.8	21.8	21.9	23.0	24.9	24.9	25.0	25.1	25.0	24.2	23.7	23.6	23.4	23.3	23.2	23.2	23.28
10	23.0	23.0	22.9	22.8	22.7	22.6	22.4	22.0	21.9	21.9	21.9	22.5	24.2	25.2	25.8	25.8	25.8	25.0	24.4	24.0	24.0	23.8	23.7	23.6	23.54
11	23.5	23.4	23.2	23.1	23.0	23.0	22.8	22.8	22.7	22.6	22.7	23.3	24.2	25.0	25.3	25.4	25.2	24.7	24.3	24.0	24.0	23.9	23.8	23.6	23.73
12	23.5	23.4	23.3	23.0	23.0	23.0	22.8	22.7	22.5	22.5	22.6	24.0	25.2	26.0	26.4	26.6	26.4	26.1	25.5	25.0	24.9	24.6	24.4	24.2	24.23
13	24.0	24.0	23.8	23.6	23.3	23.2	23.0	22.9	22.7	22.7	23.0	24.2	24.0	24.4	24.6	25.0	25.0	25.3	26.0	25.0	25.0	24.6	24.4	24.4	24.09
14	24.2	24.0	24.0	23.8	23.7	23.5	23.3	23.1	23.0	23.0	23.0	23.1	24.0	25.7	26.6	27.0	27.5	26.6	26.0	25.6	25.0	25.0	25.0	24.7	24.60
15	24.6	24.4	24.1	24.0	23.7	23.6	23.5	23.3	23.1	23.2	23.7	24.5	26.2	26.6	26.0	26.0	26.0	26.0	25.8	25.5	25.2	25.0	25.0	25.0	24.75
16	25.0	24.9	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.2	26.2	25.78
17	26.1	26.1	26.0	26.0	25.9	25.8	25.8	25.6	25.4	25.4	25.7	26.0	27.7	28.0	28.5	28.4	28.2	27.8	27.6	27.3	27.1	27.0	27.0	26.8	26.72
18	26.7	26.5	26.3	26.2	26.0	25.7	25.5	25.4	25.3	25.4	26.0	26.2	26.8	28.5	27.0	27.0	27.0	26.8	26.5	26.2	26.0	25.8	25.6	25.4	26.24
19	25.2	25.0	25.0	24.7	24.4	24.2	24.0	23.7	23.6	23.7	24.0	24.0	24.0	26.8	25.0	25.0	25.0	24.7	24.4	24.2	24.0	24.0	23.8	23.6	24.42
20	23.4	23.3	23.0	22.9	22.7	22.6	22.3	22.0	22.0	22.0	22.0	23.0	24.0	24.3	24.8	25.0	25.0	24.0	23.6	23.4	23.0	23.0	22.8	22.7	23.20
21	22.4	22.2	22.0	21.8	21.7	21.5	21.1	20.9	20.8	20.9	21.0	22.5	24.0	24.2	25.0	24.8	24.6	23.6	23.0	22.8	22.6	22.4	22.2	22.0	22.50
22	22.0	21.9	21.8	21.5	21.2	21.0	20.8	20.5	20.4	20.4	20.6	22.4	22.6	24.6	23.3	23.4	23.4	23.0	22.5	22.3	22.0	22.0	22.0	22.0	21.98
23	22.0	21.9	21.8	21.7	21.6	21.5	21.4	21.2	21.1	21.0	21.0	21.2	21.6	23.0	22.8	23.6	23.6	23.0	22.6	22.4	22.2	22.1	22.0	22.0	22.01
24	22.0	22.0	21.9	21.9	21.8	21.7	21.6	21.5	21.4	21.5	21.6	21.6	21.5	21.5	21.5	21.5	21.5	21.4	21.3	21.3	21.3	21.2	21.1	21.1	21.53
25	21.0	21.0	20.9	20.8	20.8	20.7	20.7	20.6	20.5	20.5	20.5	20.7	21.0	21.0	22.1	22.5	22.3	21.8	21.6	21.3	21.2	21.2	21.1	21.1	21.12
26	21.0	21.0	21.0	21.0	21.0	20.9	20.8	20.8	20.7	20.6	20.7	20.7	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.7	20.7	20.82
27	20.6	20.5	20.4	20.3	20.2	20.2	20.1	20.1	20.0	20.0	20.0	20.2	20.2	20.3	20.4	20.6	21.5	21.8	21.3	21.0	20.8	20.7	20.6	20.5	20.51
28	20.4	20.4	20.3	20.3	20.2	20.1	20.0	20.0	20.0	20.0	20.0	20.1	20.2	21.6	22.8	23.4	23.2	22.7	22.2	22.0	21.8	21.7	21.6	21.5	21.10

March 1993

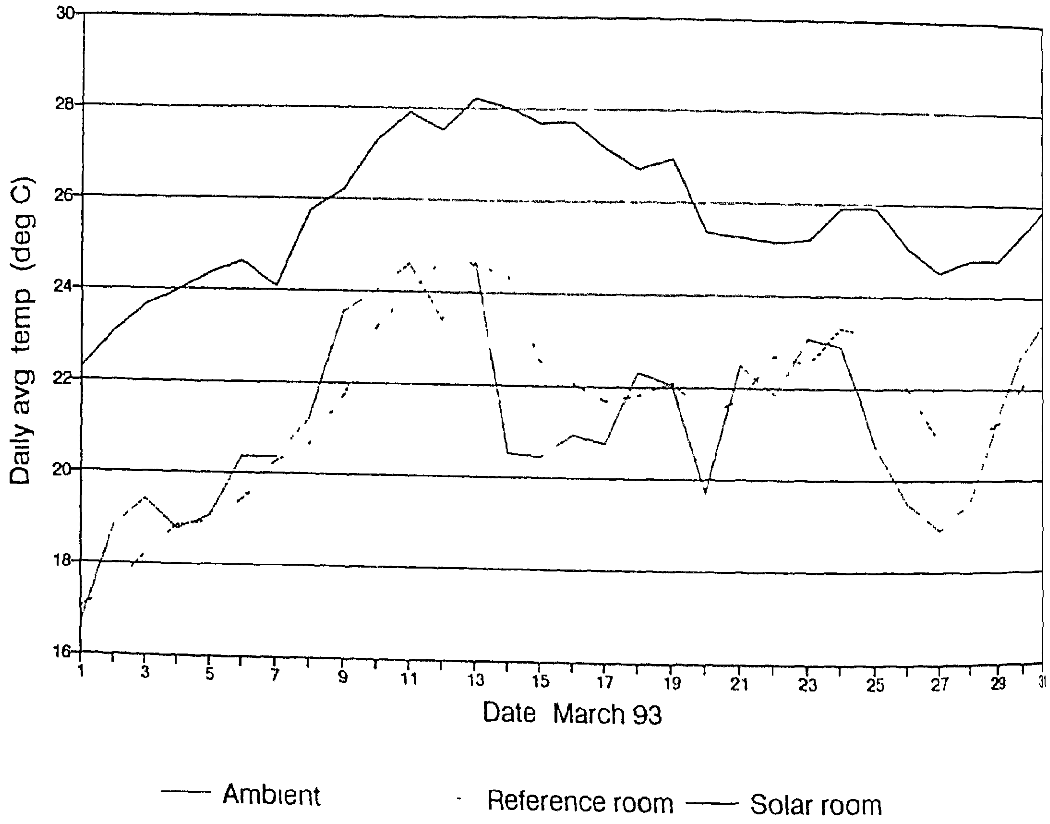

Figure: **Comparative performance monitoring of solar chimney system for March 1993**

Table: Hourly ambient temperature data for March 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	15 2	14 3	14 0	13 6	12 7	12 0	11 9	11 1	10 0	9 8	10 9	15 1	19 7	22 2	21 8	23 0	23 0	22 7	22 2	21 1	19 8	18 7	18 0	17 0	16 66
2	16 3	16 0	15 3	14 7	14 0	13 5	13 1	13 0	13 2	15 3	19 3	21 3	22 5	23 5	24 0	24 5	24 2	23 8	23 7	22 3	21 1	19 8	18 8	18 1	18 80
3	16 5	16 6	15 8	15 7	15 3	15 1	14 6	14 2	14 3	17 7	21 2	23 5	23 5	24 1	24 2	24 2	23 7	23 7	22 8	22 3	21 1	18 5	18 7	18 4	19 40
4	17 4	16 8	15 8	14 6	13 9	12 9	12 1	11 7	11 8	15 7	18 4	21 3	21 6	22 4	23 1	25 2	25 3	25 1	24 7	23 6	21 7	20 0	18 2	17 0	18 76
5	15 8	15 8	15 4	14 9	13 9	13 2	12 4	12 2	12 2	16 2	19 2	21 8	22 9	23 8	24 8	25 5	26 1	25 8	25 2	22 3	20 2	20 1	18 7	18 4	19 03
6	17 3	17 2	16 0	15 5	14 3	13 4	12 8	12 8	13 3	16 7	19 4	22 8	24 4	25 2	26 2	26 6	26 8	26 7	26 2	25 5	24 3	23 4	21 6	20 2	20 36
7	18 5	17 8	16 6	16 7	15 3	14 4	13 6	13 3	13 2	17 2	21 1	23 0	24 3	25 4	26 4	27 0	26 9	26 6	26 5	23 7	21 6	21 6	19 6	18 4	20 36
8	17 6	16 8	16 1	15 7	15 2	14 6	14 5	14 1	14 9	17 9	20 5	22 7	24 7	26 4	27 1	27 5	28 3	27 6	27 1	26 0	24 8	23 5	23 4	22 2	21 22
9	21 3	19 9	19 2	18 9	18 9	17 8	16 8	16 7	16 8	19 7	23 0	26 6	28 0	28 4	29 3	29 8	30 4	30 0	29 6	27 3	25 7	24 5	24 3	22 4	23 55
10	21 3	21 2	20 8	18 3	17 9	17 8	17 9	18 0	18 7	22 7	24 8	26 7	28 0	29 3	29 6	30 2	30 1	29 3	28 7	25 4	23 1	23 2	28 0	25 4	24 02
11	24 6	22 8	21 5	21 2	21 0	20 0	19 6	18 9	19 4	23 1	25 8	28 8	29 2	29 8	30 1	30 7	30 8	30 4	29 5	28 0	22 6	21 6	21 8	21 7	24 62
12	21 7	21 7	21 7	20 8	19 8	19 2	19 1	19 2	20 0	21 6	23 4	24 2	23 7	24 5	26 8	27 5	28 4	28 3	27 5	26 2	25 0	24 5	23 5	22 9	23 38
13	21 5	20 7	20 5	20 3	19 8	19 4	19 0	18 8	19 0	22 3	25 3	27 5	29 0	30 0	30 2	30 6	30 3	29 8	29 6	28 0	26 8	25 6	24 4	24 3	24 70
14	23 6	22 0	20 4	20 4	18 6	18 4	18 5	18 5	18 6	19 8	19 7	23 6	19 8	21 3	23 0	24 2	20 7	20 8	20 7	20 8	20 5	20 2	19 5	18 7	20 51
15	17 6	16 8	16 2	15 6	15 0	14 6	13 9	13 6	13 0	15 7	19 7	21 6	23 7	25 0	25 7	26 6	26 2	26 2	25 8	24 6	23 3	28 3	21 5	20 6	20 45
16	19 8	19 8	19 0	18 2	17 7	17 4	15 1	14 0	13 7	15 6	20 1	23 7	24 6	25 0	25 8	26 1	26 2	25 9	25 9	24 3	21 9	21 4	21 2	20 2	20 94
17	18 8	18 7	18 4	17 9	15 6	15 6	12 7	12 0	12 4	17 5	20 7	23 6	24 6	26 1	27 0	27 4	27 3	27 1	26 8	25 0	22 0	20 2	20 1	20 5	20 75
18	19 3	19 2	19 1	19 0	16 8	14 5	13 9	13 8	14 8	19 8	21 9	24 3	26 2	27 2	27 8	28 1	28 3	28 3	28 0	26 7	25 2	24 5	24 5	24 3	22 31
19	21 4	21 2	20 8	19 8	17 9	16 9	16 5	16 2	16 3	18 0	21 6	23 5	25 1	26 0	26 7	26 7	26 9	26 5	25 9	25 0	23 5	23 0	22 6	21 1	22 05
20	19 3	19 0	18 0	15 8	13 1	12 3	11 8	11 3	11 6	18 5	21 0	22 4	23 7	24 8	25 3	25 4	25 2	24 7	24 6	23 1	21 5	21 0	20 5	19 0	19 70
21	19 0	18 9	18 5	18 5	18 5	18 5	18 4	18 3	18 5	20 7	22 1	24 6	26 3	27 3	28 0	28 2	28 5	27 4	25 5	24 3	23 5	22 8	22 1	21 7	22 50
22	20 6	20 5	20 5	20 5	20 3	20 3	20 0	19 5	19 5	21 8	23 2	24 2	24 2	24 1	24 1	24 1	24 1	25 5	23 0	21 9	21 2	20 7	20 2	20 2	21 84
23	19 8	20 0	20 2	19 8	18 6	18 3	18 2	18 2	17 6	19 5	22 9	24 9	25 7	26 9	27 2	27 9	28 2	27 8	27 2	26 2	25 5	25 2	24 5	23 7	23 08
24	22 6	22 7	20 7	20 0	20 0	19 7	18 4	19 2	19 1	19 9	21 5	24 1	25 7	26 6	27 1	27 1	27 0	26 7	25 8	24 7	23 9	23 0	22 5	21 6	22 90
25	20 5	20 2	18 8	18 1	18 6	18 6	18 7	18 5	18 5	19 3	20 6	21 6	23 6	25 1	26 1	27 4	28 2	23 1	20 9	19 5	18 6	18 1	17 7	17 1	20 73
26	16 4	16 2	16 1	15 9	15 6	15 3	14 9	14 5	15 9	20 0	21 6	23 3	24 0	24 6	24 3	23 7	21 6	22 5	22 1	21 6	20 6	20 0	18 3	19 1	19 50
27	17 6	16 1	15 9	15 4	13 8	12 4	11 2	10 9	11 7	14 7	14 7	17 7	21 6	23 4	25 0	25 0	25 3	25 2	25 2	24 5	23 7	22 1	20 9	20 0	18 92
28	19 5	17 8	14 5	13 2	12 3	12 2	11 5	11 1	11 8	16 2	20 1	21 6	22 8	24 2	25 2	25 5	25 8	25 9	25 3	25 0	23 5	22 5	20 6	20 2	19 51
29	19 5	18 8	16 3	15 6	14 3	13 9	13 6	13 1	13 9	18 0	21 4	23 6	25 1	26 4	27 9	28 5	28 5	28 1	27 9	26 3	24 8	23 6	22 5	22 0	21 40
30	21 0	19 2	19 1	18 1	17 4	16 1	14 6	14 2	15 0	19 5	23 3	25 7	27 7	28 9	29 5	29 6	29 5	29 2	29 0	26 9	25 4	23 5	22 5	21 6	22 77
31	21 0	20 5	20 3	20 8	20 4	20 2	18 6	17 7	19 6	22 9	24 0	24 6	26 1	27 6	28 1	29 1	29 0	29 1	22 5	27 1	25 7	23 5	23 0	21 6	23 46

Table: Hourly reference conventional room temperature data for March 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	17.0	17.0	17.0	16.8	16.7	16.6	16.5	16.4	16.3	16.4	16.5	16.7	16.7	16.8	17.1	17.6	17.8	17.7	17.6	17.5	17.4	17.5	17.4	17.4	17.02
2	17.3	17.2	17.1	17.0	17.0	16.8	16.7	16.6	16.5	16.6	16.8	17.1	17.2	17.4	17.9	18.3	18.4	18.3	18.2	18.1	18.1	18.1	18.1	18.1	17.45
3	18.1	18.1	18.0	17.9	17.8	17.6	17.5	17.4	17.3	17.4	17.6	18.0	18.0	18.1	18.3	18.6	19.1	19.1	19.0	19.0	19.0	18.9	18.9	18.9	18.23
4	18.9	18.9	18.7	18.6	18.4	18.2	18.0	17.9	17.9	17.9	18.0	18.2	18.3	18.6	19.2	19.6	19.9	19.9	19.8	19.7	19.5	19.5	19.4	19.3	18.85
5	19.1	19.0	18.9	18.7	18.5	18.3	18.0	18.0	17.8	17.8	18.0	18.2	18.3	18.7	19.3	19.9	20.0	20.0	20.0	19.8	19.7	19.6	19.6	19.5	18.95
6	19.3	19.2	19.0	19.0	18.8	18.6	18.3	18.1	18.0	18.1	18.3	18.6	18.7	19.1	19.7	20.1	20.8	20.8	20.8	20.7	20.6	20.5	20.5	20.5	19.42
7	20.4	20.3	20.1	20.0	20.0	19.8	19.6	19.4	19.3	19.4	19.5	19.7	19.9	19.9	20.1	20.6	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	20.25
8	21.0	20.9	20.9	20.6	20.4	20.2	20.0	20.0	20.0	20.0	20.1	20.3	20.3	20.3	20.5	21.0	21.1	21.1	21.1	21.1	21.1	21.2	21.2	21.3	20.65
9	21.3	21.3	21.2	21.1	21.0	21.0	21.0	20.8	20.8	20.8	21.0	21.2	21.2	21.3	21.5	22.0	22.5	22.5	22.6	22.6	22.7	22.8	23.2	23.6	21.71
10	24.0	24.4	24.2	24.0	23.8	23.6	23.4	23.3	23.0	23.0	22.8	22.8	22.8	22.8	23.0	23.4	23.2	23.0	23.0	22.9	22.8	22.6	22.8	23.0	23.23
11	23.3	23.6	23.5	23.3	23.3	23.2	23.2	23.1	23.0	23.3	23.5	23.6	23.7	23.7	24.0	24.4	24.8	25.0	25.0	25.0	25.0	25.0	25.0	25.0	23.98
12	24.9	24.8	24.7	24.7	24.7	24.6	24.3	24.1	24.1	24.2	24.3	24.6	24.5	24.4	24.8	25.0	25.3	25.2	25.0	25.0	25.0	25.0	25.0	25.0	24.72
13	25.0	24.9	24.8	24.7	24.5	24.4	24.2	24.0	24.0	24.0	24.1	24.2	24.2	24.2	24.6	24.7	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.2	24.64
14	25.2	25.1	25.0	25.0	25.0	24.7	24.6	24.5	24.3	24.2	24.2	24.3	24.3	24.2	24.4	24.7	24.5	24.2	24.0	23.9	23.8	23.7	23.6	23.5	24.37
15	23.3	23.2	23.0	22.8	22.6	22.4	22.0	22.0	21.9	22.0	22.0	22.0	22.1	22.3	22.4	22.8	23.0	23.0	22.9	22.8	22.8	22.7	22.7	22.7	22.56
16	22.6	22.4	22.3	22.1	22.0	22.0	21.9	21.6	21.6	21.7	21.7	21.7	21.6	21.6	22.0	22.3	22.7	22.6	22.5	22.3	22.2	22.2	22.2	22.2	22.08
17	22.1	22.0	22.0	21.9	21.7	21.6	21.3	21.2	21.0	21.1	21.1	21.2	21.2	21.2	21.4	22.0	22.1	22.1	22.0	22.0	22.0	22.0	22.0	22.0	21.68
18	22.0	21.9	21.7	21.7	21.6	21.4	21.2	21.1	21.2	21.2	21.3	21.4	21.4	21.5	21.9	22.2	22.4	22.4	22.3	22.3	22.3	22.3	22.3	22.3	21.80
19	22.3	22.2	22.1	22.0	21.9	21.8	21.6	21.4	21.5	21.7	21.8	21.8	21.8	21.8	22.2	22.5	22.8	22.7	22.6	22.5	22.4	22.3	22.3	22.3	22.10
20	22.2	22.0	22.0	21.9	21.7	21.5	21.3	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.2	21.4	21.5	21.5	21.4	21.4	21.4	21.4	21.3	21.3	21.39
21	21.3	21.3	21.3	21.2	21.1	21.0	21.0	21.0	21.0	21.0	21.4	21.5	21.5	21.7	21.9	22.2	22.2	22.3	22.5	22.6	22.7	22.7	22.7	22.7	21.74
22	22.7	22.7	22.7	22.7	22.8	22.5	22.4	22.2	22.2	22.3	22.4	22.5	22.7	22.7	22.9	22.9	23.0	22.9	22.9	22.9	22.9	22.9	22.8	22.7	22.67
23	22.7	22.6	22.4	22.3	22.2	22.1	22.0	22.0	22.0	22.0	22.0	22.1	22.1	22.3	22.5	22.8	23.1	23.1	23.0	23.0	23.0	23.0	23.0	23.0	22.51
24	23.0	23.0	23.0	23.0	23.0	23.0	23.0	22.9	22.9	22.9	23.0	23.1	23.3	23.5	23.7	24.0	23.9	23.7	23.6	23.6	23.6	23.6	23.5	23.5	23.30
25	23.5	23.4	23.3	23.2	23.0	22.9	22.9	22.8	22.8	22.9	23.0	23.0	23.0	23.1	23.3	23.5	23.6	23.5	23.2	23.2	23.2	23.1	23.1	23.0	23.15
26	22.8	22.7	22.8	22.3	22.1	22.0	21.8	21.7	21.8	21.9	21.9	21.9	21.9	21.9	22.0	22.0	22.0	22.0	22.0	21.9	21.9	21.8	21.8	21.5	22.00
27	21.0	21.0	20.8	20.6	20.3	20.0	19.8	19.7	19.8	20.0	20.2	20.3	20.6	20.6	20.9	21.5	22.0	22.0	21.8	21.7	21.6	21.5	21.4	21.4	20.85
28	21.3	21.2	21.0	20.7	20.4	20.1	20.0	19.7	19.9	20.0	20.2	20.2	20.4	20.5	20.7	21.5	22.0	22.2	21.9	21.7	21.6	21.5	21.5	21.5	20.90
29	21.3	21.1	21.0	20.8	20.4	20.2	20.0	19.9	20.0	20.2	20.4	20.5	20.9	21.2	21.5	22.0	22.9	23.0	22.3	22.0	22.0	22.0	22.0	22.0	21.23
30	22.0	22.0	22.0	22.0	21.9	21.6	21.5	21.3	21.3	21.3	21.3	21.3	21.6	21.6	21.7	21.9	22.1	23.0	23.0	22.8	23.0	23.0	23.0	23.0	22.05
31	23.0	23.0	23.0	23.0	22.8	22.7	22.6	22.4	22.4	22.5	22.5	22.6	23.0	23.0	23.3	23.7	24.1	24.0	24.0	24.0	24.0	24.0	24.0	24.0	23.23

Table: Hourly solar chimney room temperature data for March 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	21.4	21.3	21.2	21.1	21.0	20.9	20.7	20.6	20.4	20.2	20.5	21.5	23.2	23.8	24.4	24.7	24.8	24.4	23.6	23.2	23.0	22.8	22.8	22.7	22.26
2	22.6	22.5	22.3	22.2	22.0	22.0	21.8	21.6	21.4	21.4	21.6	22.5	23.8	24.0	25.0	25.2	25.4	25.0	24.2	23.8	23.6	23.6	23.4	23.3	23.09
3	23.3	23.2	23.0	23.0	22.9	22.7	22.5	22.4	22.2	22.2	23.0	24.0	24.9	24.5	24.7	25.0	25.4	25.6	24.4	24.0	23.9	23.8	23.7	23.6	23.66
4	23.4	23.3	23.2	23.1	23.0	22.8	22.6	22.4	22.3	22.4	22.8	24.3	24.8	25.4	25.6	26.1	26.0	26.0	25.0	24.6	24.2	24.1	24.0	24.0	23.98
5	23.8	23.7	23.5	23.3	23.1	23.0	22.8	22.7	22.7	22.7	22.8	24.1	25.1	26.2	26.6	26.7	26.7	27.0	25.8	25.0	24.8	24.5	24.3	24.1	24.38
6	24.0	24.0	23.8	23.6	23.3	23.1	23.0	22.9	22.8	22.9	23.2	25.0	26.1	26.4	26.9	27.0	26.7	26.0	25.5	25.0	25.0	25.0	25.0	24.8	24.63
7	24.4	24.1	23.9	23.7	23.6	23.3	23.1	22.9	22.8	23.0	23.5	23.8	24.0	24.2	24.4	24.6	24.9	25.0	25.0	24.9	24.8	24.7	24.6	24.5	24.07
8	25.0	24.9	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.0	25.8	25.75
9	25.5	25.2	25.0	24.9	24.8	24.6	24.4	24.3	24.2	24.3	24.6	26.0	27.4	28.0	28.3	28.6	28.6	28.5	27.3	27.0	27.0	26.9	26.9	26.8	26.21
10	26.8	26.6	26.4	26.3	26.1	26.0	26.0	25.8	25.8	25.8	26.0	27.4	28.8	29.3	29.6	29.9	29.4	28.4	28.0	27.6	27.4	27.3	27.2	27.1	27.29
11	27.0	27.0	26.9	26.8	26.7	26.6	26.4	26.3	26.2	26.3	27.3	29.0	30.2	30.6	29.6	29.4	29.3	29.0	28.7	28.4	28.2	28.1	28.0	27.9	27.91
12	27.7	27.6	27.4	27.3	27.2	27.1	27.0	26.6	26.6	26.8	27.5	28.6	27.6	27.4	27.6	27.8	28.0	28.0	28.0	27.9	27.8	27.8	27.8	27.8	27.54
13	27.6	27.5	27.4	27.3	27.1	27.0	27.0	26.8	26.8	26.8	27.0	28.8	30.2	30.7	30.0	29.3	29.2	29.2	29.0	28.9	28.8	28.7	28.6	28.5	28.26
14	28.4	28.2	28.0	28.0	28.0	27.8	27.6	27.5	27.3	27.2	27.1	27.5	28.0	28.5	29.5	29.9	29.0	28.5	28.2	28.0	27.9	27.8	27.6	27.4	28.04
15	27.2	27.0	27.0	26.8	26.5	26.3	26.0	26.0	25.8	25.9	26.0	27.5	28.6	29.0	29.5	30.2	30.0	30.0	29.5	28.5	28.0	28.0	27.8	27.6	27.70
16	27.5	27.2	27.0	27.0	26.8	26.7	26.4	26.2	26.0	26.2	26.4	28.5	29.5	29.5	29.5	29.5	29.5	29.0	28.7	28.2	28.0	27.6	27.4	27.2	27.73
17	27.0	26.9	26.7	26.6	26.3	26.0	25.8	25.5	26.3	27.0	27.2	28.0	28.5	28.5	28.8	28.0	28.0	27.9	27.6	27.3	27.0	27.0	27.0	26.9	27.16
18	26.7	26.6	26.4	26.3	26.0	26.0	25.7	25.6	25.5	25.6	25.7	27.2	27.9	27.4	27.3	27.5	27.9	27.7	27.3	27.0	27.0	27.0	26.9	26.8	26.71
19	26.7	26.6	26.4	26.2	26.0	26.0	26.8	26.6	26.6	26.7	26.8	27.0	27.5	27.5	27.6	27.8	28.0	28.5	27.5	27.0	27.0	26.9	26.8	26.6	26.96
20	26.4	26.2	26.0	25.4	25.0	24.8	24.5	24.0	24.1	24.3	24.6	25.0	25.2	25.5	26.2	26.4	26.2	25.8	25.7	25.7	25.6	25.6	25.5	25.3	25.38
21	25.1	25.0	25.0	25.0	25.0	24.9	24.6	24.4	24.2	24.3	24.6	25.0	25.5	25.4	25.8	26.0	26.0	26.0	26.0	25.9	25.8	25.8	25.7	25.6	25.28
22	25.5	25.4	25.3	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.6	25.5	25.4	25.3	25.3	25.3	25.2	25.0	25.0	25.0	25.0	25.0	25.0	25.16
23	24.9	24.8	24.7	24.6	24.2	24.0	23.9	23.9	24.0	24.0	24.2	25.1	25.2	25.6	26.3	26.8	27.2	26.6	26.3	26.0	26.0	25.8	25.7	25.6	25.23
24	25.6	25.5	25.4	25.3	25.2	25.1	25.0	25.0	25.0	25.0	25.0	25.7	26.3	26.8	27.2	27.5	27.0	26.8	26.5	26.4	26.3	26.2	26.2	26.1	25.92
25	26.0	26.0	25.9	25.8	25.7	25.6	25.5	25.4	25.5	25.6	25.8	26.0	26.3	26.4	26.5	26.6	26.5	26.2	26.0	26.0	26.0	25.8	25.7	25.5	25.93
26	25.3	25.1	25.0	25.0	24.8	24.6	24.5	24.6	24.7	25.0	25.4	25.7	25.4	25.4	25.3	25.2	25.3	25.2	25.1	25.0	25.0	25.0	24.8	24.7	25.05
27	24.5	24.3	24.0	23.8	23.6	23.4	23.2	23.6	23.7	24.0	24.5	24.6	25.0	25.5	25.3	25.5	25.5	25.2	25.0	25.0	25.0	25.0	24.9	24.7	24.53
28	24.6	24.2	23.9	23.8	23.2	23.0	23.0	23.2	23.5	23.7	24.6	25.5	26.7	26.7	27.0	26.4	26.0	25.8	25.5	25.1	25.0	25.0	25.0	24.6	24.78
29	24.4	24.1	24.0	23.9	23.6	23.4	23.4	23.6	23.9	24.0	24.7	25.0	25.0	25.3	25.6	26.0	26.5	26.1	25.7	25.6	25.4	25.4	25.3	25.2	24.80
30	25.0	25.0	24.9	24.6	24.3	24.1	24.0	24.3	24.6	24.9	25.4	25.9	26.0	25.8	25.7	25.8	26.0	26.2	26.0	26.0	26.0	26.0	26.0	25.9	25.35
31	25.8	25.7	25.6	25.4	25.3	25.1	25.0	25.2	25.4	25.5	25.7	26.0	26.0	26.0	26.2	26.5	26.5	26.6	26.7	26.5	26.4	26.4	26.4	26.3	25.93

April 1993

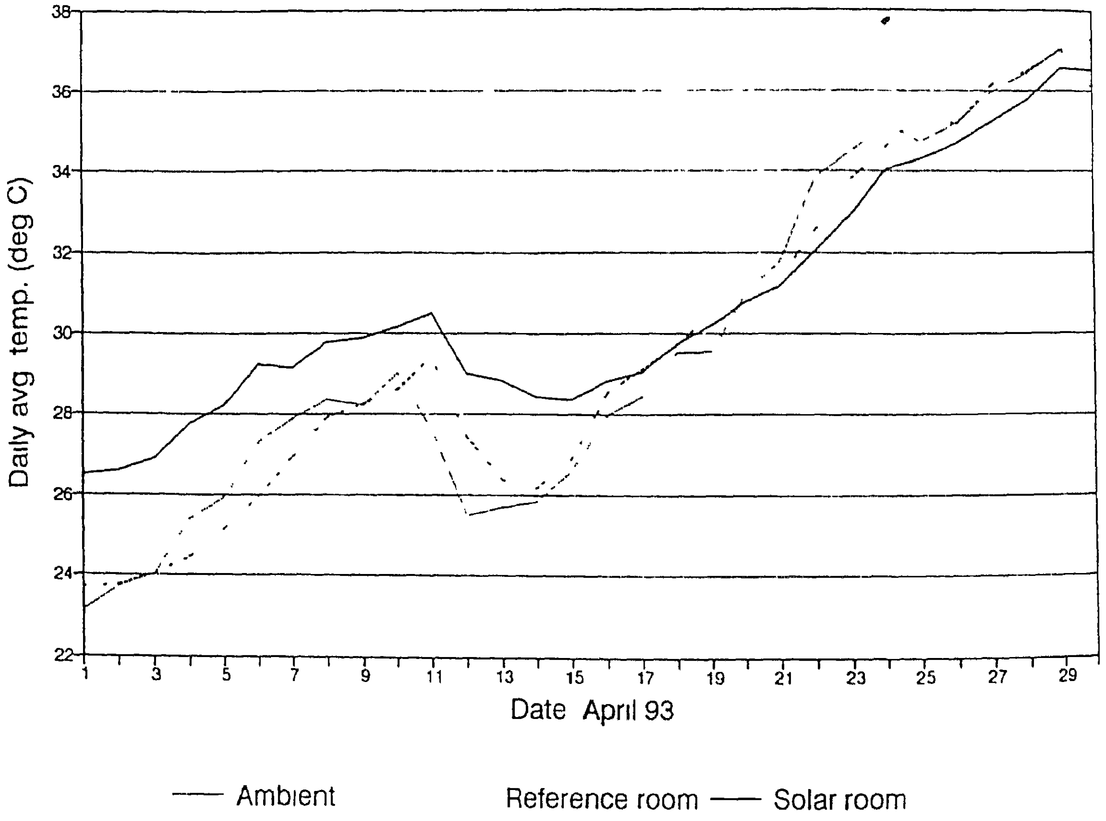

Figure: **Comparative performance monitoring of solar chimney system for April 1993**

Table: Hourly ambient temperature data for April 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	20.4	20.0	18.3	17.7	17.3	16.6	15.0	14.9	16.0	21.7	24.4	26.6	28.2	28.7	29.4	29.9	29.9	29.4	29.0	27.4	26.0	25.0	22.[illegible]	20.9	23.12
2	19.8	18.1	17.3	16.3	17.6	16.9	15.7	14.4	16.1	20.7	24.0	26.5	28.3	30.4	31.4	31.5	31.7	31.5	31.1	29.8	27.6	25.2	23	23.3	23.74
3	22.6	20.8	19.2	18.2	17.5	17.0	16.0	15.1	16.3	20.2	23.2	26.0	28.5	29.8	30.9	31.2	31.0	31.0	30.1	28.7	27.0	25.7	25.[illegible]	25.0	24.03
4	23.7	22.8	22.0	21.2	19.8	18.1	14.7	14.7	16.2	20.9	23.8	27.7	30.4	31.3	32.6	32.5	32.3	32.3	31.7	30.4	29.0	28.0	[illegible]	[illegible]	25.38
5	23.8	23.2	22.8	22.4	20.8	18.1	16.9	16.3	17.5	22.3	25.3	23.2	30.3	31.5	32.8	33.1	33.0	33.2	32.7	31.6	29.7	28.6	27	[illegible]	25.93
6	25.3	25.2	24.7	23.4	21.7	20.7	20.6	19.7	21.2	24.6	26.5	28.3	30.8	31.9	33.0	33.3	33.8	33.6	33.4	31.9	30.3	29.0	[illegible]	[illegible]	[illegible]
7	26.2	24.5	24.4	23.5	22.3	22.9	22.4	21.4	22.6	24.0	28.4	28.0	30.1	32.3	33.9	33.8	33.6	33.4	31.9	30.4	30.4	30.0	[illegible]	[illegible]	[illegible]
8	28.4	27.3	26.0	25.7	24.0	23.3	22.9	20.5	21	25.2	27.6	29.8	31.9	32.9	33.5	33.4	33.9	33.7	33.2	32.2	30.8	30.0	23	[illegible]	28.38
9	26.5	25.4	25.3	22.5	21.3	26.4	19.5	19.5	2 0	26.3	29.3	31.3	32.1	33.0	33.9	34.4	34.4	34.5	33.9	31.9	30.3	29.0	[illegible]	[illegible]	28.23
10	26.6	25.8	24.2	23.5	23.0	21.8	21.3	21.2	22.2	26.8	27.7	32.1	33.7	34.5	35.0	35.5	35.0	35.0	34.3	33.2	31.8	31.4	30.[illegible]	[illegible]	29.00
11	26.2	28.4	28.4	27.2	26.6	26.1	25.6	25.1	24.4	27.1	28.6	30.9	32.5	33.0	33.6	32.9	30.9	26.1	26.3	26.4	25.8	23.5	23	[illegible]	27.62
12	23.7	23.6	23.5	23.4	23.3	23.6	22.8	22.7	22.9	22.9	23.0	25.6	28.6	30.2	31.1	31.9	31.1	30.4	26.0	26.0	25.1	24.0	23.[illegible]	[illegible]	25.47
13	21.9	21.9	21.0	20.5	20.2	20.1	20.1	20.2	21.4	25.1	26.8	28.0	30.5	32.5	33.5	32.9	33.1	32.6	32.3	26.8	26.9	23.5	22.[illegible]	[illegible]	25.68
14	22.6	21.9	22.0	22.2	22.0	21.6	21.4	21.5	21.8	23.6	26.0	28.4	30.1	31.7	32.8	33.4	33.2	33.0	32.1	30.1	24.2	21.5	21.[illegible]	[illegible]	25.84
15	22.0	21.9	21.7	21.3	21.0	20.4	19.9	19.9	21.2	24.8	28.4	30.6	32.4	33.3	34.4	30.5	30.0	31.0	31.3	30.5	29.8	28.9	27.[illegible]	[illegible]	26.59
16	24.2	23.1	22.3	21.4	21.4	20.9	20.9	20.5	22.4	26.0	28.7	30.5	32.5	33.6	34.6	35.0	34.9	34.6	34.0	32.6	30.7	29.8	28.[illegible]	27.8	27.97
17	26.9	25.7	24.5	23.6	20.7	21.5	20.1	19.6	21.6	25.2	28.4	31.1	32.5	33.1	34.5	34.7	35.3	35.1	35.0	33.8	32.1	30.9	27.[illegible]	28.4	28.43
18	25.8	26.3	24.2	22.9	22.3	21.5	20.9	20.5	22.4	26.0	29.8	31.9	34.2	35.1	35.5	36.3	36.8	36.4	36.1	34.9	33.4	32.4	31.7	31.0	29.51
19	27.4	25.4	25.3	24.3	22.8	21.9	21.5	21.5	23.4	27.1	30.8	31.4	33.5	33.8	36.3	36.3	36.3	36.3	36.3	35.5	33.7	31.6	28.[illegible]	27.7	29.54
20	26.5	25.4	25.0	24.2	23.4	22.5	21.3	21.8	24.6	28.4	32.3	34.2	35.6	37.0	38.0	38.1	38.2	38.4	38.2	36.7	35.6	34.5	33.0	29.9	30.95
21	28.5	27.9	27.2	24.8	24.0	23.4	23.2	23.3	24.8	29.8	32.8	35.4	37.2	30.0	39.3	39.9	38.7	39.1	38.7	37.3	36.1	34.7	33.7	32.7	31.77
22	31.7	31.3	30.7	27.6	25.7	24.8	24.8	24.8	26.0	30.8	34.5	36.6	38.1	39.1	40.6	41.1	41.1	41.0	40.8	39.0	37.2	36.1	35.[illegible]	34.3	33.87
23	33.3	32.4	31.1	29.6	28.2	27.3	27.0	26.7	27.5	31.4	35.5	37.5	39.5	39.9	40.3	40.8	40.9	41.6	40.6	38.7	38.1	33.8	33.0	33.2	34.50
24	36.4	33.7	31.7	30.5	29.9	28.2	27.7	23.0	29.8	34.2	38.3	39.0	39.6	39.2	40.1	40.6	41.4	41.1	40.5	39.0	37.2	35.7	34.2	33.4	35.18
25	31.5	31.4	30.2	27.5	27.0	26.3	26.1	26.6	29.3	33.1	35.5	37.8	39.1	40.1	41.0	42.1	42.5	42.2	41.6	40.3	38.8	36.6	33.8	33.1	34.72
26	32.0	31.1	30.2	29.7	29.6	28.8	28.3	28.4	29.5	34.0	36.9	37.5	39.3	40.1	41.5	42.5	42.8	42.3	40.4	39.1	36.8	35.8	34.4	33.9	35.20
27	32.9	31.9	30.4	30.4	30.3	29.0	28.6	28.4	28.8	32.8	36.5	38.0	40.0	41.4	42.5	42.8	43.4	43.6	42.7	41.1	40.6	37.6	35.7	33.7	35.95
28	32.9	31.9	30.9	30.1	30.0	29.1	29.0	29.0	30.2	34.1	36.9	39.1	40.5	41.9	42.8	43.2	43.4	43.2	42.9	41.8	41.0	39.1	36.5	34.8	36.43
29	33.2	33.0	32.8	31.7	30.5	30.0	29.0	29.9	30.9	35.5	37.7	40.1	41.5	42.5	44.1	44.0	43.5	43.5	43.0	41.8	40.0	38.1	37.0	35.2	37.02
30	34.0	33.5	32.6	31.9	30.4	29.9	29.3	28.2	29.5	31.6	34.3	36.2	38.2	40.8	42.1	42.2	43.5	43.4	43.0	41.6	39.5	38.6	36.0	35.1	36.06

Table: Hourly reference conventional room temperature data for April 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	24.0	24.0	24.0	24.0	23.8	23.6	23.4	23.3	23.3	23.3	23.2	23.1	23.0	23.0	23.3	23.6	24.2	24.3	24.2	24.1	24.1	24.1	24.1	24.0	23.71
2	24.0	24.0	23.8	23.6	23.4	23.2	23.0	22.9	22.9	22.9	22.8	22.8	23.0	23.0	23.4	24.0	24.6	24.8	24.7	24.7	24.7	24.7	24.7	24.7	23.76
3	24.6	24.5	24.4	24.2	24.0	23.8	23.6	23.4	23.4	23.3	23.3	23.2	23.3	23.5	23.7	24.0	24.2	24.6	24.6	24.6	24.7	24.7	24.7	24.6	24.04
4	24.5	24.4	24.3	24.2	24.2	24.1	24.0	23.8	23.8	23.8	23.7	23.7	23.8	24.0	24.5	24.8	25.0	25.2	25.1	25.0	25.0	25.2	25.3	25.4	24.45
5	25.4	25.4	25.2	25.1	25.0	24.9	24.7	24.6	24.7	24.7	24.6	24.5	24.4	24.6	24.7	25.0	25.4	25.8	25.8	25.8	25.8	25.8	25.9	26.0	25.16
6	26.0	25.9	25.8	25.7	25.5	25.4	25.2	25.4	5.3	25.4	25.4	25.3	25.4	25.5	25.6	25.9	26.4	26.9	26.7	26.7	26.8	26.9	26.9	27.0	25.96
7	27.0	26.9	26.8	26.7	26.5	26.4	26.3	26.2	26.1	26.0	26.2	26.3	26.3	26.5	26.8	27.6	27.9	27.9	27.7	27.7	27.8	27.8	27.8	27.8	26.98
8	27.8	27.8	27.7	27.6	27.5	27.4	27.2	27.2	27.3	27.3	27.2	27.2	27.4	27.6	27.9	28.4	28.9	29.0	28.7	28.6	28.6	28.6	28.6	28.6	27.92
9	28.5	28.4	28.3	28.2	28.0	27.9	27.7	27.6	27.7	27.8	27.7	27.7	27.7	27.8	27.9	28.4	28.7	28.8	28.8	28.8	28.9	28.9	28.9	28.9	28.25
10	29.0	28.8	28.7	28.6	28.4	28.2	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.1	28.3	28.6	29.0	29.0	29.0	29.1	29.3	29.4	29.5	29.6	28.61
11	29.6	29.6	29.6	29.5	29.5	29.4	29.3	29.1	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.6	29.7	29.7	29.7	29.5	29.1	29.0	29.44
12	28.9	28.6	28.4	28.2	28.0	27.8	27.6	27.4	27.3	27.1	27.0	26.9	26.9	26.9	27.0	27.0	27.6	27.4	27.2	27.1	27.0	27.0	27.0	27.0	27.43
13	26.3	26.3	26.0	25.8	25.9	25.9	25.9	25.8	25.9	25.9	25.8	25.9	26.0	26.3	26.6	27.0	27.2	27.2	27.4	27.0	27.0	27.2	26.8	26.0	26.38
14	25.5	25.3	25.3	25.2	25.0	24.9	25.0	25.4	25.8	25.9	26.0	26.2	26.6	26.5	26.8	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	26.18
15	26.9	26.8	26.7	26.6	26.4	26.3	26.0	26.0	26.4	26.4	26.2	26.4	26.8	26.9	27.0	27.0	27.5	27.7	27.5	27.6	27.6	27.7	27.7	27.7	26.91
16	29.3	29.2	29.1	29.0	28.9	28.7	28.5	28.3	28.5	28.6	28.2	28.3	28.3	28.3	28.3	28.2	28.2	28.2	28.3	28.3	28.2	28.4	28.5	28.8	28.53
17	29.0	28.9	28.9	28.8	28.8	28.7	28.6	28.5	28.5	28.6	28.7	29.3	29.1	29.0	29.0	29.2	29.4	29.6	29.7	29.8	29.7	29.8	29.8	29.8	29.13
18	30.0	30.0	29.7	29.5	29.3	29.3	29.4	29.3	29.3	29.4	29.5	29.6	29.8	30.1	30.2	30.0	30.1	30.0	30.0	29.9	29.9	29.6	29.5	29.7	29.71
19	30.3	30.2	30.1	30.0	29.9	29.8	29.8	29.7	29.8	30.2	30.1	30.1	30.0	30.4	30.6	30.6	30.9	31.5	31.5	31.3	31.2	31.1	31.1	31.1	30.47
20	•	•	•	•	•	•	•	•	•				30.6	30.8	31.0	31.6	32.0	31.9	31.9	31.9	31.8	31.7	31.6	31.6	15.77
21	31.4	31.2	31.0	30.8	30.6	30.4	30.2	30.1	30.5	30.7	30.7	30.8	31.0	31.3	31.8	32.0	32.1	32.2	32.2	32.2	32.2	32.3	32.4	32.4	31.35
22	32.4	32.4	32.3	32.2	32.0	31.9	31.8	31.7	31.8	32.0	31.9	32.0	32.5	32.6	32.6	32.7	33.0	33.3	33.3	33.4	33.4	33.5	33.5	33.6	32.58
23	33.7	33.6	33.6	33.5	33.3	33.2	33.0	32.9	32.9	33.0	33.0	33.0	33.4	33.6	33.6	34.0	34.8	35.2	35.0	34.7	34.7	34.7	34.7	34.7	33.83
24	34.7	34.7	34.7	34.5	34.4	34.3	34.1	34.0	34.1	34.4	34.3	34.3	34.3	34.3	34.4	34.5	34.8	35.0	35.1	35.1	35.1	35.1	35.1	35.1	34.60
25	35.2	35.1	35.0	34.9	34.7	34.7	34.6	34.6	34.9	35.0	35.1	35.2	35.5	35.8	35.8	35.8	36.8	36.3	36.1	36.1	36.0	35.8	35.6	35.5	35.42
26	35.3	35.3	35.2	35.0	35.0	34.9	34.7	34.5	34.6	34.8	34.8	34.7	34.7	34.7	34.8	34.9	35.1	35.6	35.8	35.8	35.9	35.9	36.0	36.0	35.17
27	36.0	36.0	36.0	36.0	36.0	35.9	35.8	35.7	35.6	35.7	35.8	35.6	35.9	35.9	36.0	36.0	36.5	36.8	36.7	36.7	36.7	36.7	36.7	36.7	36.14
28	36.7	36.6	36.5	36.4	36.2	36.0	35.9	35.8	35.9	36.0	35.8	35.8	35.9	36.1	36.3	36.5	36.8	37.4	37.3	37.2	37.1	37.1	37.1	37.1	36.48
29	37.1	37.0	37.0	36.8	36.6	36.5	36.3	36.2	36.3	36.4	36.4	36.4	36.6	36.8	37.0	37.2	37.4	37.8	37.7	37.7	37.6	37.6	37.6	37.6	36.98
30	37.7	37.6	37.5	37.4	37.2	37.0	36.9	36.8	37.0	37.2	37.0	37.0	36.8	37.0	37.0	37.0	37.4	37.7	37.7	37.6	37.6	37.8	37.6	37.6	37.29

Table: Hourly solar chimney room temperature data for April 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	26 2	26 1	26 0	26 0	25 9	25 8	25 6	25 6	25 8	25 9	26 0	26 5	26 8	27 0	27 2	27 4	27 3	27 3	27 3	27 0	27 0	27 0	26 8	26 6	26 50
2	26 4	26 2	26 0	25 8	25 6	25 5	25 2	25 2	25 5	25 7	26 0	26 6	26 8	26 9	27 0	27 5	28 0	28 0	27 8	27 6	27 4	27 3	27 1	27 0	26 59
3	27 0	26 9	26 7	26 6	26 4	26 2	26 0	26 0	26 0	26 1	26 2	26 6	26 9	27 0	27 3	27 5	28 0	27 8	27 6	27 5	27 4	27 4	27 3	27 3	26 90
4	27 1	27 1	27 0	27 0	26 8	26 6	26 4	26 3	26 6	26 7	27 5	27 5	27 7	28 0	28 5	29 3	29 5	29 4	29 1	28 8	28 6	28 5	28 3	28 1	27 70
5	28 0	27 5	27 1	27 0	26 7	26 4	26 0	26 0	26 3	27 0	27 7	28 1	28 9	29 8	30 0	30 0	30 0	30 0	30 0	29 5	29 1	29 0	28 9	28 5	28 23
6	28 4	28 3	28 1	28 0	28 0	27 8	27 5	27 2	27 4	28 1	28 5	28 9	29 7	30 4	30 6	31 4	31 6	31 4	31 0	30 5	30 0	30 0	29 7	29 5	29 25
7	29 0	28 8	28 6	28 5	28 4	28 3	28 1	28 0	28 0	27 9	27 7	29 4	29 4	29 6	29 6	30 0	30 0	30 2	30 0	30 0	30 0	30 0	30 0	30 0	29 15
8	29 9	29 8	29 7	29 5	29 0	28 7	28 4	28 6	28 9	29 2	29 8	29 4	29 7	30 0	30 1	30 7	31 0	31 0	30 7	30 5	30 4	30 3	30 1	30 0	29 79
9	29 8	29 6	29 4	29 3	29 0	28 7	28 6	28 7	28 9	29 0	29 4	29 5	29 8	30 0	30 3	30 7	30 8	30 9	31 0	31 0	30 9	30 9	30 7	30 5	29 89
10	30 2	29 9	29 6	29 2	29 0	28 8	28 8	29 0	29 2	29 4	29 6	29 9	30 1	30 6	31 0	31 1	31 2	31 1	31 0	31 0	31 0	31 0	31 0	30 8	30 15
11	30 7	30 6	30 6	30 6	30 4	30 1	30 0	30 0	30 0	30 0	30 3	30 6	31 0	31 1	31 3	31 4	31 0	30 8	30 8	30 5	30 2	29 8	29 9	29 7	30 48
12	29 6	29 6	29 3	29 1	29 0	28 8	28 6	28 7	28 7	28 7	28 6	28 4	28 6	28 7	29 0	29 2	29 4	29 3	29 3	29 2	29 2	29 2	29 0	29 0	29 01
13	28 8	28 6	28 4	28 3	28 1	28 0	27 9	28 0	28 3	28 4	28 5	28 6	29 0	29 5	29 6	29 7	29 7	29 9	29 8	29 4	29 0	29 0	28 6	28 7	28 83
14	28 6	28 5	28 4	28 3	28 0	28 0	28 0	28 0	28 0	28 0	28 2	28 3	28 3	28 4	28 6	28 9	29 0	29 0	29 0	29 0	28 5	28 4	28 4	28 3	28 42
15	28 1	28 0	27 8	27 6	27 3	27 1	27 0	27 3	27 5	27 7	28 0	28 2	28 5	28 7	29 2	29 4	29 5	29 5	29 3	29 1	29 1	29 1	29 0	29 0	28 38
16	28 8	28 7	28 5	28 2	28 0	27 5	27 4	27 4	27 3	27 5	28 1	28 6	29 2	29 9	30 1	30 2	30 3	30 1	30 0	29 6	29 5	29 1	29 0	28 6	28 82
17	28 3	28 4	28 1	28 1	28 0	28 0	27 8	27 7	27 4	27 6	28 2	28 7	29 2	29 9	30 0	30 4	30 6	30 6	30 2	30 0	30 0	30 0	29 9	29 6	29 03
18	29 4	29 1	29 0	28 8	28 6	28 5	28 3	28 1	28 3	28 5	28 9	29 3	29 9	30 4	31 0	31 2	31 3	31 1	31 0	30 7	30 6	30 7	30 5	30 2	29 73
19	30 0	29 9	29 5	29 2	29 0	28 8	28 5	28 6	28 7	28 8	29 0	29 2	29 5	30 6	31 0	31 7	32 1	32 0	31 8	31 5	31 5	31 4	31 1	30 9	30 18
20	30 7	30 4	30 2	30 0	29 7	29 5	29 2	29 3	29 6	29 7	29 9	30 0	30 3	31 0	31 7	32 3	32 4	32 5	32 0	31 8	31 8	31 7	31 6	31 2	30 77
21	31 0	30 6	30 3	30 0	30 0	29 6	29 5	29 6	29 7	30 0	30 3	30 5	31 2	31 5	32 2	32 5	32 7	32 8	32 7	32 5	32 4	32 4	32 3	32 0	31 18
22	31 8	31 6	31 3	31 0	30 8	30 5	30 3	30 2	30 6	31 0	31 4	31 7	31 9	32 4	32 6	33 3	33 4	33 5	33 5	33 4	33 4	33 3	33 1	33 0	32 04
23	32 8	32 6	32 5	32 2	32 0	31 8	31 7	31 6	31 7	32 0	32 4	32 6	32 7	33 0	33 4	33 8	34 0	34 2	34 3	34 0	34 0	34 0	34 0	33 8	32 96
24	34 0	34 0	33 6	33 5	33 2	33 0	32 7	32 7	32 8	33 0	33 4	33 7	34 0	34 3	34 7	34 9	35 2	35 5	35 0	35 0	35 0	35 0	35 0	34 7	34 08
25	34 9	34 7	34 7	34 6	34 2	34 1	33 7	33 2	33 1	33 2	33 3	33 5	34 0	34 3	34 3	34 5	34 9	34 9	35 0	35 2	35 3	35 0	34 5	34 5	34 32
26	33 9	33 8	33 7	33 5	33 6	33 4	33 3	33 3	33 5	33 8	34 0	34 0	34 5	35 2	35 8	36 3	36 7	36 8	36 5	36 0	35 7	35 4	35 2	35 2	34 71
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28	35 8	35 5	35 2	35 1	35 0	35 0	34 7	34 7	34 7	34 8	35 0	35 0	35 2	35 5	36 1	36 5	36 8	37 0	37 0	36 9	36 9	36 9	36 9	36 8	35 79
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30	37 0	37 0	36 9	36 7	36 5	36 3	36 0	35 9	36 0	36 2	36 3	36 3	36 4	36 6	37 0	37 3	37 2	36 6	36 6	36 3	36 3	36 3	36 3	36 2	36 51

May 1993

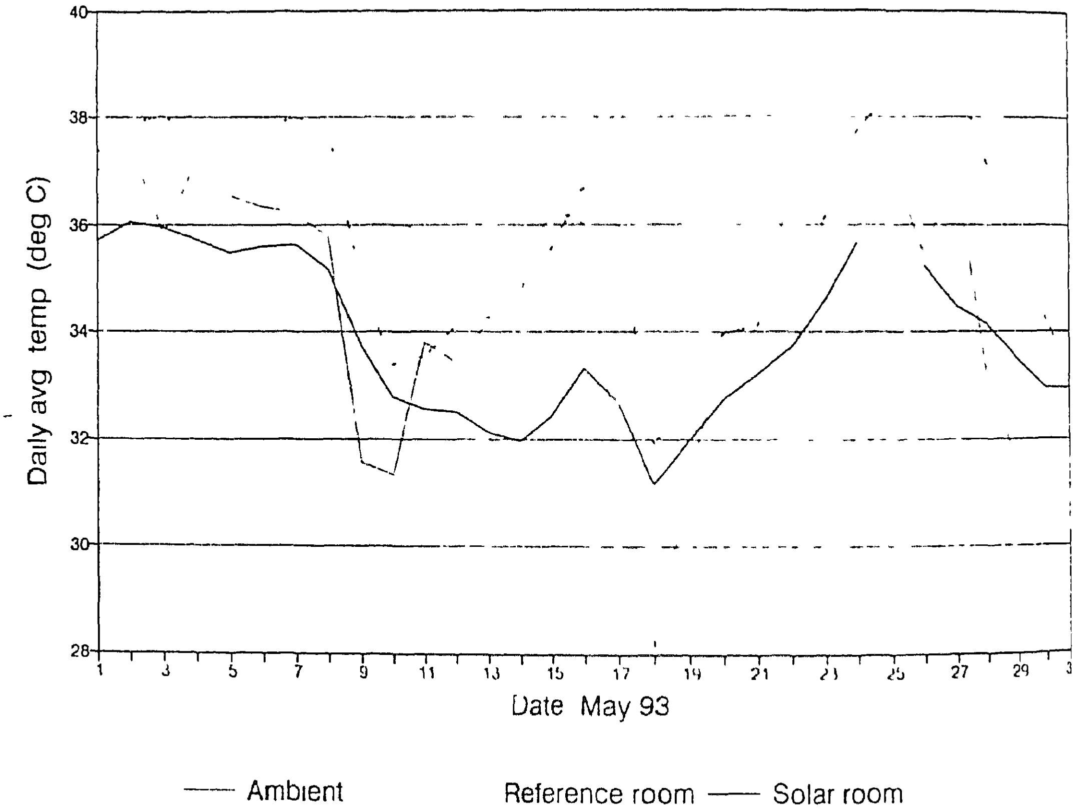

Figure: Comparative performance monitoring of solar chimney system for May 1993

Table: Hourly ambient temperature data for May 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	34.0	32.8	31.6	31.2	30.5	28.7	29.2	29.8	31.6	34.6	37.2	39.1	41.5	42.6	43.3	44.1	44.0	43.9	43.2	42.2	41.2	38.0	37.1	36.1	36.99
2	35.1	34.4	33.2	32.0	31.8	30.8	30.0	30.1	31.4	35.5	38.8	40.3	41.0	42.5	43.3	45.0	44.5	44.2	44.0	42.8	39.2	38.1	37.0	36.3	37.55
3	35.8	35.7	34.8	33.0	32.2	31.4	30.5	29.8	29.9	32.1	33.9	36.4	37.6	38.7	39.9	40.7	41.2	41.2	40.9	39.3	37.5	36.6	35.4	34.7	35.80
4	33.9	32.3	31.2	30.3	30.2	29.0	29.2	38.2	28.5	34.9	37.2	40.3	42.1	43.1	43.6	44.1	44.1	44.0	43.4	41.9	40.9	36.5	36.3	36.0	37.13
5	34.2	33.0	31.5	28.7	29.2	28.8	28.4	28.2	28.7	35.4	38.4	40.2	42.2	42.6	43.1	43.1	43.6	43.6	43.2	41.8	40.1	37.9	36.3	34.3	36.52
6	33.2	31.8	30.8	29.6	28.5	27.9	27.1	27.9	29.6	34.7	37.2	39.8	41.2	42.7	43.4	44.0	43.9	43.8	43.6	41.9	40.4	37.8	36.0	35.3	36.34
7	34.1	33.1	31.7	30.4	28.8	28.7	28.2	28.0	30.0	35.0	37.3	39.6	40.8	41.5	42.2	43.5	43.8	43.7	43.5	40.5	38.3	36.8	35.3	34.0	36.21
8	33.0	32.1	31.4	30.6	30.4	29.6	28.5	28.4	30.2	34.4	37.1	37.7	38.6	40.2	40.9	41.7	42.0	42.2	42.3	40.4	38.3	37.1	36.0	35.2	35.76
9	33.0	30.2	30.1	27.9	27.0	27.0	25.0	24.7	5.2	27.4	30.4	32.1	33.5	35.0	36.5	36.8	37.3	37.1	37.0	35.5	33.6	32.4	31.6	31.0	31.55
10	30.5	30.5	30.5	30.5	30.5	29.7	29.0	28.7	28.6	29.8	31.4	28.7	29.5	31.3	33.2	33.7	34.5	34.4	35.0	34.7	33.0	32.0	31.4	30.8	31.33
11	30.3	29.9	29.5	29.2	29.3	28.9	28.5	28.1	28.1	28.1	31.5	33.6	35.2	37.3	38.6	41.8	41.5	41.2	40.5	38.6	36.8	36.5	34.8	33.3	33.80
12	32.0	31.9	30.5	28.0	28.5	27.6	26.5	26.6	26.7	28.9	31.8	34.5	36.8	37.9	39.2	39.5	40.4	40.3	39.8	38.9	37.3	34.1	32.7	32.3	33.45
13	32.1	31.0	29.0	28.1	26.9	26.5	25.8	25.9	27.8	32.5	35.8	37.6	39.1	39.3	40.1	40.5	40.8	40.5	40.4	38.9	36.9	35.8	34.6	34.0	34.16
14	32.6	32.2	31.3	29.4	28.1	26.6	25.8	25.7	28.1	32.4	35.2	37.6	38.4	39.8	40.8	41.3	41.5	42.1	41.7	40.2	37.2	36.1	34.4	33.3	34.66
15	32.4	32.4	31.4	30.7	30.2	28.6	28.2	28.7	30.9	35.6	36.3	40.4	41.1	43.1	43.6	43.6	43.2	43.3	42.7	41.0	39.2	36.0	35.2	34.6	36.35
16	34.6	33.0	31.4	30.8	30.4	29.6	29.1	28.2	30.8	36.0	38.0	39.0	39.1	40.5	40.8	41.5	41.9	41.8	41.4	40.6	38.2	37.2	36.0	35.0	36.04
17	34.3	33.2	32.6	31.9	31.6	31.1	31.1	31.2	32.0	34.0	35.1	31.8	34.6	34.2	34.7	34.9	32.8	30.8	31.5	31.2	30.4	29.9	25.7	21.7	31.76
18	20.7	20.9	20.9	21.2	21.4	21.6	21.6	21.8	23.2	25.7	27.9	29.5	31.4	32.9	33.8	34.7	34.8	34.8	35.2	34.1	32.6	32.0	31.4	31.0	29.13
19	30.0	29.8	29.5	29.0	27.8	26.8	26.4	26.8	27.8	30.0	32.9	34.9	35.5	36.3	31.8	32.6	33.0	33.1	33.0	33.0	36.2	35.1	31.5	30.5	31.39
20	29.9	29.4	29.3	28.6	28.4	28.4	28.0	27.5	28.0	30.9	33.2	34.8	36.9	38.0	38.6	39.3	39.1	39.4	39.0	38.0	36.7	35.1	33.7	33.0	33.47
21	31.5	30.9	30.5	29.8	28.9	28.4	28.3	28.2	28.5	30.4	32.2	35.1	36.7	37.3	38.9	39.8	40.6	40.4	40.4	39.5	37.7	35.7	34.4	33.7	34.08
22	32.9	31.9	31.4	30.0	29.8	29.5	29.5	29.5	30.6	34.3	36.6	39.5	41.1	42.1	42.8	43.4	44.0	43.9	43.5	42.5	41.1	39.1	38.1	33.1	36.68
23	36.2	35.0	34.2	33.5	33.1	33.0	32.8	32.2	32.7	35.0	37.0	39.0	40.7	42.0	43.0	43.6	44.0	44.0	42.3	42.2	39.5	39.7	37.4	36.4	37.85
24	35.2	34.5	33.8	33.2	32.2	31.4	31.1	31.2	32.8	30.0	33.0	40.0	41.2	42.6	43.9	43.0	44.0	44.5	44.0	43.1	41.6	40.2	37.6	37.3	37.56
25	35.1	34.5	33.4	32.8	32.0	31.3	30.3	30.5	32.3	35.0	37.0	39.9	41.8	41.9	43.0	42.9	42.7	42.1	40.6	40.0	39.1	38.4	37.7	37.0	37.14
26	36.1	35.5	35.1	34.5	33.4	22.2	21.4	21.2	21.9	34.1	35.8	37.4	39.1	40.0	41.0	42.2	42.5	42.6	42.5	41.2	39.4	38.3	37.1	36.4	35.45
27	35.6	35.3	35.0	34.7	34.1	34.0	34.0	32.6	32.5	34.5	37.3	39.1	40.2	41.5	42.5	42.9	43.0	42.9	43.1	37.8	35.6	35.3	33.6	31.4	37.02
28	30.2	30.2	30.2	30.2	30.2	30.0	28.1	28.0	23.1	29.8	32.3	33.6	35.2	36.6	37.8	38.5	39.0	39.5	39.5	38.7	35.6	34.1	32.6	31.5	33.10
29	30.0	28.9	28.4	28.0	28.0	26.5	26.1	26.1	26.6	28.6	30.0	31.3	32.7	34.3	36.2	37.0	37.6	38.2	38.2	36.3	34.1	31.7	30.6	30.0	31.48
30	29.5	29.5	29.1	28.8	28.8	28.8	27.6	22.3	27.3	27.7	29.2	31.2	33.0	34.6	35.6	36.4	37.0	37.3	37.8	37.2	35.8	34.7	33.7	33.2	31.92
31	32.2	31.3	28.0	27.7	27.7	27.2	27.2	27.2	27.9	31.3	31.8	33.2	32.7	32.8	32.0	32.4	33.2	33.8	34.7	34.4	33.0	32.0	31.2	30.9	31.08

Table: Hourly reference conventional room temperature data for May 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	37 6	37 6	37 5	37 5	37 4	37 3	37 0	36 7	36 7	36 8	36 9	36 9	36 9	36 9	37 0	37 1	37 5	37 7	37 8	37 8	37 8	37 9	38 0	38 0	37 35
2	38 0	38 0	38 0	37 9	37 8	37 6	37 5	37 3	37 3	37 5	37 5	37 5	37 5	37 6	37 7	37 8	38 0	38 3	38 3	38 3	38 3	38 3	38 3	38 5	37 87
3	38 5	38 5	38 4	38 3	38 0	37 9	37 7	37 6	37 6	37 7	37 8	37 8	37 8	37 7	37 8	38 0	38 0	38 4	38 2	38 2	38 1	38 1	38 1	38 1	38 01
4	38 0	38 0	38 0	37 8	37 8	37 6	37 4	37 3	37 2	37 4	37 4	37 2	37 2	37 2	37 3	37 4	38 0	38 3	38 0	37 9	37 9	37 9	37 9	37 9	37 67
5	37 9	37 7	37 6	37 5	37 1	37 0	36 8	36 8	36 8	36 9	36 9	36 8	37 4	37 5	37 9	38 2	38 4	38 8	38 7	38 6	38 4	38 4	38 4	38 4	37 70
6	38 2	38 0	37 9	37 7	37 4	37 0	36 4	36 2	36 2	36 8	36 8	37 0	37 4	37 7	37 8	38 2	38 5	38 8	38 8	38 8	38 8	38 8	38 7	38 5	37 77
7	38 4	38 3	38 0	37 9	37 6	37 4	37 0	36 8	36 7	36 9	37 0	37 4	37 6	37 9	38 1	38 4	38 6	39 0	39 0	38 9	38 8	38 8	38 8	38 7	38 00
8	38 5	38 3	38 2	38 0	37 0	36 9	36 9	37 0	37 2	37 7	37 4	37 4	37 5	37 7	37 8	38 0	38 2	38 3	38 3	38 3	38 3	38 3	38 0	37 8	37 79
9	37 5	37 2	36 2	36 2	35 7	35 2	34 6	33 6	33 7	34 1	33 5	33 9	34 1	34 4	34 6	34 7	34 9	35 0	35 0	35 0	34 9	34 8	34 7	34 7	34 93
10	34 7	34 5	34 5	34 0	33 7	33 5	33 5	33 3	32 7	32 4	32 9	33 0	32 8	32 9	33 0	33 2	33 3	33 4	33 3	33 3	33 3	33 3	33 3	33 3	33 38
11	33 3	33 2	33 2	33 2	33 1	33 0	33 0	33 0	33 0	33 0	33 2	33 2	33 2	33 3	33 3	34 0	34 4	34 3	34 3	34 3	34 1	34 1	34 1	34 1	33 54
12	34 0	34 0	33 8	33 7	33 7	33 5	33 3	33 2	33 2	33 3	33 1	33 3	33 7	34 1	34 5	34 3	34 7	35 0	35 0	35 0	35 0	34 9	34 9	34 8	34 08
13	34 7	34 5	34 1	33 9	33 6	33 3	33 0	32 9	33 2	33 6	33 4	33 6	33 9	34 0	34 3	34 8	35 2	35 4	35 3	35 1	35 0	35 0	35 0	35 0	34 24
14	35 0	35 0	34 8	34 7	34 4	34 2	33 8	33 8	33 9	34 0	33 8	33 7	33 7	33 7	33 9	34 2	34 5	34 9	35 0	35 0	35 0	35 2	35 2	35 3	34 45
15	35 3	35 3	35 2	35 1	35 0	34 9	34 8	34 8	34 9	35 0	34 9	34 8	34 8	34 9	35 0	35 7	36 1	36 2	36 4	36 5	36 6	36 8	36 9	36 9	35 53
16	36 9	36 9	36 9	36 7	36 4	36 3	36 0	36 0	35 2	36 4	36 3	36 2	36 2	36 3	36 5	36 7	36 9	37 1	37 2	37 2	37 2	37 3	37 3	37 3	36 68
17	37 3	37 3	37 2	37 0	36 9	36 7	36 5	36 4	36 3	36 3	36 3	35 9	36 1	36 1	36 0	36 2	36 1	36 0	36 0	35 8	35 5	35 5	35 4	31 5	36 10
18	31 7	31 7	31 8	31 5	31 4	31 3	31 0	31 0	31 0	31 2	31 6	31 8	31 8	32 0	32 1	32 3	32 7	33 0	32 7	32 5	32 4	32 4	32 4	32 4	31 90
19	32 4	32 2	32 2	32 2	32 0	31 9	31 8	32 0	32 3	32 2	32 0	32 5	32 7	32 8	33 4	33 5	33 8	33 7	33 7	33 7	33 7	33 8	33 8	33 8	32.84
20	33 8	33 8	33 7	33 5	33 4	33 2	33 0	32 9	33 2	33 3	33 3	33 4	33 6	33 7	34 0	34 5	34 9	34 9	34 9	34 8	34 8	34 7	34 7	34 7	33.95
21	34 4	34 4	34 2	34 0	33 9	33 7	33 3	33 3	33 6	33 7	33 7	33 6	33 5	33 5	33 9	34 0	34 5	34 6	34 7	34 9	34 8	34 7	34 8	34 8	34 10
22	34 8	34 6	34 4	34 1	33 9	33 7	33 5	33 6	33 8	34 0	34 0	34 1	34 2	34 0	34 1	34 4	35 2	35 6	35 7	35 8	35 8	35 9	35 9	35 9	34 63
23	35 8	35 7	35 6	35 3	35 2	35 0	35 0	34 9	35 1	35 3	35 4	35 5	35 6	35 8	36 1	36 5	36 8	37 3	37 5	37 5	37 5	37 5	37 5	37 4	36 12
24	37 3	37 2	37 0	36 9	36 7	36 6	36 4	36 1	36 9	36 8	36 8	36 6	36 9	37 5	38 0	38 7	38 8	39 2	39 2	39 3	39 2	39 2	39 1	39 0	37 73
25	38 9	38 7	38 6	38 4	38 2	38 0	37 7	37 6	38 4	38 1	38 0	37 8	37 9	38 2	38 3	38 5	39 0	39 2	39 2	39 2	39 2	39 1	39 1	39 0	38 51
26	38 9	38 8	38 8	38 7	38 4	38 0	37 9	38 3	38 3	38 3	38 0	38 0	38 0	38 3	38 3	38 9	39 5	39 5	39 5	39 4	39 4	39 4	39 0	39 0	38 69
27	38 6	38 6	38 7	38 7	38 5	38 2	38 0	38 3	38 3	38 4	38 3	38 3	38 5	39 0	39 4	39 8	39 8	39 9	39 9	39 6	39 4	39 3	39 0	38 0	38 85
28	38 0	38 0	38 0	37 8	37 3	36 7	36 1	36 5	37 0	36 8	36 6	36 6	36 6	36 8	36 9	37 0	37 3	37 6	37 6	37 6	37 5	37 4	37 2	37 0	37 16
29	36 6	36 4	36 0	35 6	35 1	34 8	34 4	34 6	34 8	34 9	34 9	34 8	34 8	34 9	35 0	35 0	35 2	35 6	35 6	35 7	35 7	35 5	35 0	34 8	35 24
30	34 8	34 8	34 8	34 8	34 5	34 2	34 0	33 9	33 9	33 3	33 1	33 2	33 6	33 8	33 9	34 0	34 2	34 5	34 7	34 8	34 8	34 8	34 8	34 7	34 25
31	34 7	34 7	34 1	33 4	32 8	32 5	32 1	32 3	32 9	32 8	32 9	33 0	33 0	33 0	32 8	32 8	33 0	33 3	33 3	33 3	33 2	33 1	33 1	33 1	33 13

Table: Hourly solar chimney room temperature data for May 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	36 0	35 8	35 9	35 8	35 6	35 2	35 0	34 6	34 6	34 6	34 7	35 0	35 2	35 4	35 6	35 9	36 1	36 2	36 3	36 5	36 6	36 7	36 7	36 6	35 69
2	36 4	36 3	36 1	36 0	35 8	35 6	35 4	35 3	35 3	35 4	35 4	35 5	35 5	35 7	36 1	36 7	36 8	36 6	36 4	36 6	36 8	36 7	36 6	36 5	36 06
3	36 4	36 3	36 1	35 9	35 7	35 5	35 2	34 8	35 0	35 1	35 3	35 5	35 8	35 9	36 1	36 3	36 4	36 5	36 5	36 5	36 5	36 5	36 4	36 3	35 94
4	36 2	36 0	36 0	35 8	35 6	35 3	35 1	35 0	35 0	35 1	35 2	35 0	35 1	35 5	35 8	36 2	36 3	36 0	36 0	36 2	36 4	36 3	36 1	36 0	35 72
5	35 9	35 7	35 4	35 2	35 0	35 0	34 8	34 8	34 8	34 8	34 9	35 0	35 0	35 4	34 6	36 2	36 3	36 1	36 0	36 1	36 1	36 1	36 2	36 1	35 48
6	36 0	35 8	35 5	35 3	35 0	35 0	34 8	34 8	34 8	34 8	34 8	34 8	35 3	35 5	35 7	35 9	36 1	36 3	36 3	36 3	36 3	36 3	36 3	36 2	35 58
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8	35 6	35 4	35 2	35 0	34 8	34 6	34 5	34 4	34 6	34 8	34 8	34 8	34 8	34 8	35 0	35 1	35 3	35 5	35 6	35 8	35 8	35 8	35 8	35 6	35 14
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12	32 9	32 9	32 6	32 5	32 3	32 3	32 2	32 1	32 0	32 0	32 0	32 0	32 0	32 0	32 4	32 7	32 9	33 0	33 0	33 0	33 0	33 0	32 9	32 7	32 52
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18	30 8	30 9	30 9	30 9	30 9	30 9	30 7	30 6	30 5	30 3	30 3	30 4	30 5	31 0	31 3	31 4	31 6	31 8	31 9	32 0	32 0	32 0	32 0	32 0	31 15
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22	33 8	33 8	33 8	33 7	33 6	33 4	33 3	33 2	33 1	33 1	33 1	33 1	33 2	33 4	33 7	33 8	34 0	34 0	34 1	34 2	34 3	34 4	34 4	34 5	33 71
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25		•	•	•		•	•	•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	0 00
26	35 0	34 8	34 8	34 7	34 4	33 7	34 1	34 7	35 0	35 2	35 2	35 3	35 3	35 5	36 0	36 3	36 6	36 9	36 5	36 4	35 2	34 8	34 6	34 8	35 24
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31	32 8	32 6	32 5	32 2	32 0	31 8	31 7	31 6	31 7	32 0	32 4	32 6	32 7	33 0	33 4	33 8	34 0	34 2	34 3	34 0	34 0	34 0	34 0	33 8	32 96

June 1993

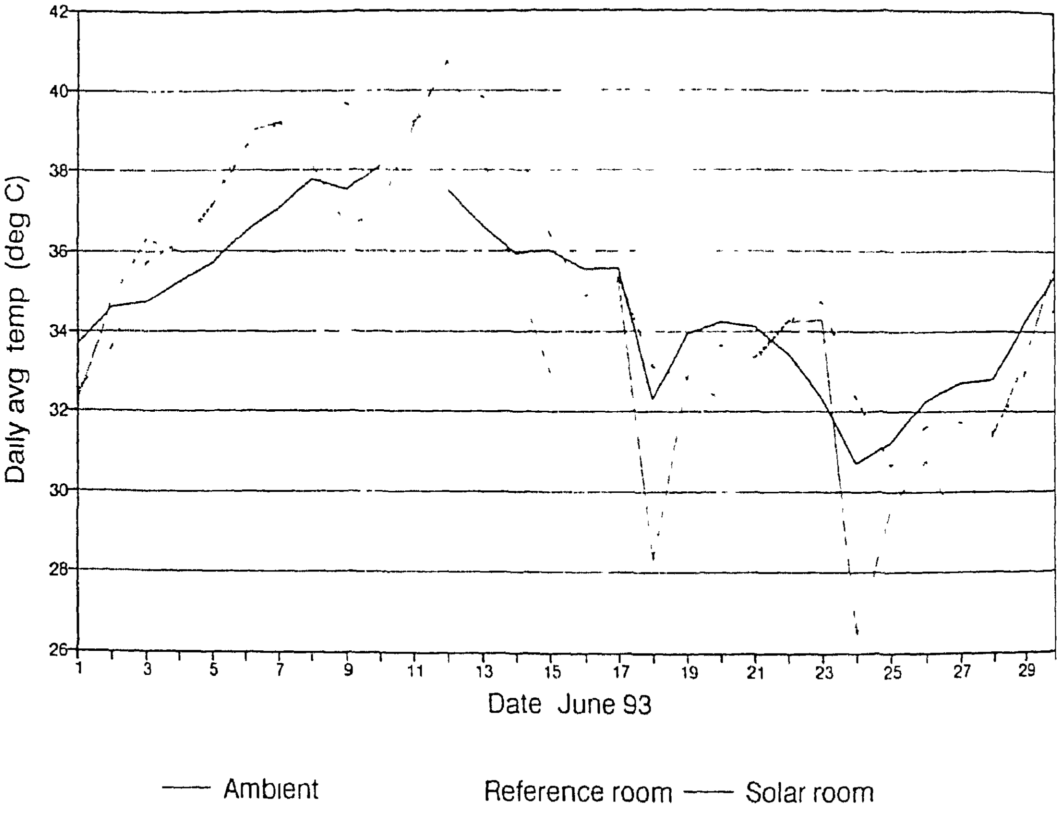

Figure: **Comparative performance monitoring of solar chimney system for June 1993**

Table: Hourly ambient temperature data for June 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	30.1	29.7	29.7	28.8	28.7	28.6	28.7	29.7	29.2	28.7	29.3	31.0	30.7	31.6	34.2	35.6	36.8	37.1	37.3	37.3	36.6	36.0	34.8	33.7	32.25
2	32.5	31.5	30.2	28.8	28.7	27.2	27.0	27.7	30.2	32.3	35.1	37.0	37.6	39.0	40.1	40.6	40.6	40.6	40.5	40.0	39.2	37.4	36.0	36.0	34.83
3	35.3	33.9	33.3	32.5	32.3	30.7	30.4	30.4	32.9	34.6	37.0	38.0	39.8	40.7	41.5	42.4	42.3	42.6	42.0	41.4	35.6	34.4	33.6	33.5	36.29
4	33.3	32.5	31.8	30.0	29.6	29.7	31.5	31.7	32.5	32.7	33.6	38.9	40.7	41.5	42.2	42.4	43.0	43.4	41.5	39.5	37.2	35.7	34.9	34.0	35.99
5	33.2	31.6	31.5	30.5	30.1	29.5	29.5	29.9	32.1	34.5	38.6	39.8	41.6	42.8	43.3	43.3	43.8	43.5	43.4	42.4	41.8	40.2	38.4	36.7	37.17
6	35.9	35.9	34.7	33.8	32.6	32.0	32.8	32.0	34.8	37.3	39.7	41.7	42.1	43.4	44.3	44.8	45.2	45.1	44.6	43.7	42.1	40.3	38.7	37.3	38.95
7	36.1	35.0	34.8	34.7	34.2	33.5	32.8	32.9	35.1	37.9	39.4	40.4	41.9	43.4	44.1	44.8	45.0	45.2	45.0	44.1	42.5	40.8	39.5	38.1	39.22
8	37.0	36.4	35.8	34.3	34.0	32.5	31.9	31.8	31.9	33.5	35.5	38.3	41.0	42.7	43.7	45.1	45.4	45.4	44.7	42.1	40.0	38.7	37.5	36.7	38.16
9	35.5	34.1	34.0	33.7	33.0	32.0	31.1	30.9	31.0	32.5	34.3	36.1	37.7	39.1	40.0	41.1	42.1	42.6	42.3	40.7	39.8	39.0	37.8	36.9	36.55
10	35.4	33.9	33.1	31.7	31.0	30.0	29.0	29.0	30.0	32.7	35.1	37.6	40.4	42.6	44.6	45.5	44.4	45.6	43.6	41.5	39.4	38.4	37.6	36.8	37.04
11	36.4	34.7	33.9	33.3	32.4	32.2	31.6	31.4	31.7	35.0	39.2	41.3	43.3	43.9	44.9	45.9	46.3	46.1	45.8	44.4	42.0	41.4	41.3	40.6	39.13
12	39.0	37.4	37.8	37.7	36.9	35.9	34.3	34.3	37.4	38.6	40.0	40.7	42.8	44.0	45.0	45.5	46.1	46.1	45.8	44.7	43.0	44.0	40.2	40.0	40.72
13	38.9	38.1	37.7	37.0	36.6	36.6	35.6	34.6	34.7	37.2	37.2	37.7	39.1	39.6	40.5	40.6	40.7	46.7	40.2	39.8	39.2	38.8	38.2	37.7	38.46
14	36.5	36.5	36.2	35.5	34.3	33.7	33.6	33.3	32.7	34.0	34.6	35.3	36.6	37.3	37.8	38.2	38.2	37.9	36.5	35.4	34.4	33.4	33.2	32.9	35.33
15	32.9	32.9	31.9	31.3	31.3	31.3	31.3	31.3	32.3	33.0	34.5	34.8	36.1	37.1	37.5	37.4	37.6	36.1	30.7	30.2	30.2	30.0	29.8	29.8	32.97
16	29.8	29.9	29.9	29.7	29.6	29.2	29.1	29.1	23.3	31.0	32.8	34.2	36.0	37.0	37.8	38.6	38.8	39.1	39.1	38.2	36.6	35.8	35.1	34.3	33.75
17	34.0	33.0	32.5	32.3	31.5	30.8	29.8	29.5	30.0	32.1	34.2	36.2	37.8	38.2	39.7	40.2	40.4	40.4	40.6	38.8	37.3	36.1	35.7	35.3	35.27
18	25.1	22.9	23.0	23.0	23.3	23.1	23.0	23.2	24.1	26.5	28.1	29.3	30.3	30.8	30.8	33.2	34.0	34.5	34.4	33.3	31.8	30.8	30.7	30.0	28.30
19	29.6	29.4	29.0	28.8	28.7	28.7	28.8	28.8	23.9	30.5	30.9	32.9	34.8	35.6	37.2	37.8	38.1	38.9	38.4	38.0	37.0	35.7	34.2	32.6	32.85
20	31.6	30.9	30.6	30.4	30.3	30.2	30.1	30.1	30.5	32.4	35.0	35.9	37.0	33.3	38.5	37.4	33.9	33.2	32.3	30.6	30.4	30.4	30.4	29.8	32.30
21	28.9	28.9	28.4	28.2	28.0	28.0	28.0	28.4	29.9	31.7	34.0	35.7	37.0	38.2	38.3	40.0	40.0	39.8	39.8	35.6	33.0	32.5	32.5	32.1	33.20
22	31.5	30.9	30.0	29.6	29.4	29.4	29.4	29.4	29.5	32.2	34.0	36.1	38.7	39.1	40.6	40.8	40.7	40.7	40.3	35.3	34.6	34.2	32.9	32.7	34.25
23	32.4	32.0	31.5	31.2	30.6	30.3	30.1	30.3	30.9	31.8	32.7	34.7	35.7	37.6	38.2	39.2	38.2	38.2	38.2	37.3	36.5	35.5	34.8	34.4	34.26
24	33.7	31.0	27.0	26.2	26.0	25.5	25.4	25.7	25.5	25.5	25.5	25.5	25.1	25.1	25.1	25.2	25.4	25.9	26.9	26.8	26.8	26.7	26.5	26.4	26.43
25	26.1	26.0	26.0	26.0	26.0	26.0	25.9	25.9	26.1	27.8	29.1	30.5	31.6	32.6	32.8	33.5	33.6	33.7	33.7	33.1	32.0	31.5	30.9	30.0	29.59
26	29.1	29.0	28.6	28.2	28.0	27.6	27.5	27.6	23.1	29.0	29.8	31.4	32.5	33.5	34.4	34.7	35.6	34.9	34.2	33.6	32.5	31.9	31.4	30.8	30.79
27	30.4	29.9	29.5	29.4	29.1	29.0	28.6	28.6	29.2	30.2	30.5	25.1	22.3	25.2	27.6	29.8	31.2	31.1	30.8	30.7	30.1	29.8	29.6	29.5	29.05
28	29.0	26.5	28.0	27.8	27.6	27.4	27.2	27.2	28.0	29.3	30.1	31.6	32.9	34.3	34.8	35.3	36.8	37.3	36.9	35.5	34.0	33.0	32.3	31.0	31.41
29	30.0	29.3	28.9	28.9	28.4	28.4	28.4	28.4	29.3	31.9	33.7	35.7	36.3	37.7	38.9	29.4	40.2	40.0	38.3	37.4	36.0	35.2	34.8	34.0	33.31
30	33.7	32.9	32.4	31.5	30.8	30.0	29.5	29.6	31.1	34.5	35.8	37.7	38.7	39.6	40.8	41.1	41.3	41.3	40.8	40.0	36.7	36.2	35.4	34.1	35.65

Table: Hourly reference conventional room temperature data for June 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	33.0	33.0	33.0	32.9	32.8	32.3	32.0	32.0	31.9	31.9	31.9	31.8	31.8	31.8	32.0	32.5	32.8	33.0	33.0	32.8	32.9	32.9	33.0	33.0	32.50
2	33.0	33.0	32.9	32.7	32.6	32.4	32.3	32.5	32.7	32.7	32.8	32.9	33.0	33.4	33.9	34.2	34.5	34.7	34.9	35.0	35.0	35.0	35.1	35.2	33.60
3	35.2	35.2	35.1	35.0	34.9	34.8	34.7	34.8	35.1	35.1	35.1	35.2	35.6	35.8	36.0	36.3	36.4	36.7	36.8	36.8	36.7	36.7	36.7	36.7	35.73
4	36.6	36.5	36.3	36.2	36.0	36.0	35.0	35.0	35.1	35.1	35.0	35.3	35.8	36.3	36.3	36.6	36.8	37.0	37.3	37.2	37.1	37.0	37.0	37.0	36.23
5	37.0	36.8	36.7	36.5	36.3	36.0	35.8	35.9	36.0	36.2	36.4	36.6	36.7	37.0	37.4	37.7	38.0	38.3	38.4	38.6	38.5	38.4	38.3	38.3	37.16
6	38.1	38.0	38.0	37.9	37.8	37.7	37.4	37.6	37.8	37.9	38.0	38.0	38.2	38.5	38.8	39.1	39.4	39.8	39.9	40.0	39.8	39.8	39.7	39.6	38.62
7	39.4	39.2	39.0	38.9	38.7	38.5	38.1	38.0	38.3	38.4	38.5	38.7	38.7	38.9	39.1	39.3	39.5	39.8	40.1	40.3	40.2	40.2	40.2	40.2	39.18
8	40.0	40.0	39.9	39.8	39.4	39.3	39.4	39.4	39.5	39.6	39.6	39.6	39.6	39.6	39.7	40.0	40.0	40.5	40.5	40.5	40.5	40.5	40.5	40.5	39.91
9	40.3	40.0	40.0	40.0	39.9	39.6	39.3	39.3	39.6	39.7	39.5	39.0	39.1	39.2	39.2	39.4	39.8	40.0	40.0	39.9	39.9	39.9	39.8	39.7	39.67
10	39.6	39.4	39.3	39.2	39.0	38.8	38.5	38.4	38.6	38.8	38.5	38.2	38.5	38.7	38.9	39.1	39.5	40.0	39.6	39.6	39.6	39.6	39.5	39.5	39.10
11	39.4	39.3	39.2	39.1	38.7	38.5	38.2	38.2	38.3	38.5	38.6	38.6	38.8	39.0	39.2	39.5	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	39.21
12	39.9	39.7	39.6	39.4	39.1	39.0	38.7	38.6	38.5	38.8	39.0	39.3	39.5	39.8	40.1	40.3	40.7	41.2	41.0	41.0	40.6	40.6	40.5	40.4	39.80
13	40.3	40.2	40.0	39.9	39.8	39.7	39.6	39.4	39.4	39.5	39.5	39.5	39.5	39.7	39.9	40.0	40.0	40.3	40.3	40.1	40.0	40.0	40.0	40.0	39.86
14	40.0	40.0	39.9	39.8	39.8	39.7	39.4	39.4	39.1	39.0	38.3	38.4	38.4	38.5	38.5	38.6	38.7	38.7	38.4	38.0	37.9	37.6	37.6	37.6	38.80
15	37.5	37.3	37.0	36.7	36.7	36.7	36.2	36.0	36.0	36.0	36.2	36.4	36.6	37.0	37.0	37.0	37.1	35.5	35.7	35.9	35.9	36.0	35.8	35.8	36.41
16	35.4	35.4	35.2	35.0	34.8	34.6	34.2	34.3	34.5	34.7	34.7	34.7	34.7	34.7	34.7	34.8	35.0	35.2	35.1	35.0	35.0	35.0	35.0	35.0	34.88
17	35.0	35.0	35.0	35.0	35.0	34.8	34.6	34.7	35.0	35.0	35.0	34.8	35.2	35.3	35.4	35.5	35.6	36.2	36.2	36.1	36.1	36.1	36.1	36.1	35.37
18	35.0	34.0	33.0	32.8	33.0	33.0	33.0	33.0	32.8	32.8	32.7	32.7	33.0	33.0	32.9	33.0	33.2	33.5	33.3	33.1	33.0	33.0	33.0	33.0	33.12
19	32.9	32.9	32.9	32.8	32.6	32.5	32.3	32.3	32.1	32.1	32.1	32.2	32.3	32.5	32.7	32.8	33.0	33.5	33.6	33.6	33.6	33.6	33.7	33.7	32.85
20	33.8	33.8	33.8	33.7	33.6	33.6	33.6	33.6	33.7	33.7	33.8	33.9	34.1	34.0	34.0	33.9	34.0	34.0	33.4	33.4	33.3	33.3	33.0	33.0	33.67
21	33.0	32.9	32.7	32.6	32.5	32.4	32.3	32.3	32.5	32.6	32.7	32.8	33.0	33.4	33.5	34.5	34.3	34.8	34.4	34.3	34.2	34.2	34.1	34.1	33.34
22	33.9	33.7	33.5	33.2	33.2	33.3	33.4	33.5	33.4	33.6	33.8	34.0	34.3	34.5	34.9	35.0	35.2	35.5	35.2	35.0	35.0	35.0	34.9	34.8	34.24
23	34.8	34.8	34.7	34.4	34.4	34.3	34.3	34.2	34.0	33.9	33.8	34.0	34.5	35.0	35.1	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.2	35.2	34.74
24	35.1	35.0	34.9	34.6	34.4	34.2	33.8	33.5	32.5	32.1	31.9	31.8	31.6	31.0	31.2	31.0	31.5	31.4	31.3	31.0	30.9	30.8	30.7	30.6	32.37
25	30.4	30.3	30.2	30.1	29.9	29.9	29.8	29.8	30.1	30.2	30.3	30.4	30.7	31.0	31.0	31.0	32.0	31.5	31.3	31.3	31.2	31.2	31.2	31.0	30.66
26	31.0	31.0	31.0	31.0	31.0	30.9	30.9	30.9	31.1	31.2	31.3	31.4	31.7	31.8	32.0	32.1	32.6	32.4	32.3	32.3	32.3	32.3	32.3	32.3	31.63
27	32.2	32.2	32.2	32.1	32.0	32.0	31.9	32.0	32.0	32.3	32.3	31.3	30.7	31.0	31.5	31.8	31.7	31.7	31.7	31.6	31.5	31.4	31.3	31.2	31.73
28	31.1	31.0	30.9	30.9	30.8	30.8	30.5	30.7	31.0	31.0	31.0	31.2	31.3	31.4	31.6	32.0	32.0	32.7	32.4	32.3	32.3	32.3	32.3	32.3	31.48
29	32.3	32.3	32.0	32.0	32.0	32.0	32.0	32.2	32.6	32.8	32.6	32.7	32.8	32.9	33.0	33.3	33.6	33.9	34.0	34.0	34.0	34.0	34.0	33.9	32.95
30	33.8	33.7	33.5	33.3	33.0	32.9	32.8	32.9	33.4	33.7	34.0	34.3	34.8	35.2	35.8	35.9	36.2	36.0	36.0	36.0	35.8	35.7	35.5	35.4	34.57

Table: Hourly solar chimney room temperature data for June 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	33 8	33 8	33 8	33 7	33 6	33 4	33 3	33 2	33 1	33 1	33 1	33 1	33 2	33 4	33 7	33 8	34 0	34 0	34 1	34 2	34 3	34 4	34 4	34 5	33 71
2	34 5	34 5	34 5	34 5	34 5	34 5	34 2	34 2	34 0	34 0	34 0	34 0	34 2	34 3	34 5	34 7	34 8	35 0	35 0	35 1	35 2	35 3	35 4	35 4	34 60
3	33 9	33 8	33 7	33 5	33 6	33 4	33 3	33 3	33 5	33 8	34 0	34 0	34 5	35 2	35 8	36 3	36 7	36 8	36 5	36 0	35 7	35 4	35 2	35 2	34 71
4	35 0	34 8	34 8	34 7	34 4	33 7	34 1	34 7	35 0	35 2	35 2	35 3	35 3	35 5	36 0	36 3	36 6	36 9	36 5	36 4	35 2	34 8	34 6	34 8	35 24
5	36 2	36 0	36 0	35 8	35 6	35 3	35 1	35 0	35 0	35 1	35 2	35 0	35 1	35 5	35 8	36 2	36 3	36 0	36 0	36 2	36 4	36 3	36 1	36 0	35 72
6	36 2	36 3	36 4	36 2	36 0	35 8	35 6	35 5	35 5	35 6	35 8	35 9	36 3	36 5	36 9	37 1	37 2	37 3	37 4	37 3	37 3	37 3	37 3	37 3	36 50
7	37 4	37 6	37 2	36 8	36 2	36 3	36 2	36 1	36 5	36 8	36 8	36 9	37 1	37 5	37 9	37 9	37 6	37 5	37 4	37 1	37 3	37 2	37 3	37 1	37 07
8	37 2	37 1	36 9	37 0	37 2	37 3	37 1	37 0	37 0	37 1	37 3	37 4	37 8	38 27	38 4	38 6	38 7	38 8	38 9	38 8	38 4	38 2	37 9	37 8	37 76
9	37 7	37 6	37 4	37 2	37 0	36 8	36 6	36 5	36 5	36 6	36 8	36 9	37 3	37 5	37 9	38 1	38 2	38 3	38 4	38 3	38 3	38 3	38 3	38 3	37 53
10	38 4	38 1	38 0	37 5	37 6	37 2	36 8	36 2	36 4	37 0	37 5	37 8	37 8	38 0	38 1	38 3	38 5	38 7	39 0	39 5	39 9	39 7	39 5	39 4	38 12
11	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				•	•	•		•	0 00
12	37 7	37 6	37 4	37 2	37 0	36 8	36 6	36 5	36 5	36 6	36 8	36 9	37 3	37 5	37 9	38 1	38 2	38 3	38 4	38 3	38 3	38 3	38 3	38 3	37 53
13	38 0	37 5	37 2	36 9	36 5	36 1	35 9	35 8	36 1	36 6	36 8	36 9	36 8	36 5	36 9	36 7	36 7	36 5	36 4	36 4	36 5	36 4	36 3	36 3	36 61
14	36 4	36 3	36 1	35 9	35 7	35 5	35 2	34 8	35 0	35 1	35 3	35 5	35 8	35 9	36 1	36 3	36 4	36 5	36 5	36 5	36 5	36 5	36 4	36 3	35 94
15	36 7	36 6	36 4	36 2	36 0	35 8	35 6	35 5	35 5	35 6	35 8	35 9	36 3	36 5	36 9	36 7	36 4	36 3	36 0	35 7	35 5	35 6	35 5	35 5	36 02
16	35 4	35 3	35 2	35 0	34 8	34 6	34 6	34 8	35 0	35 2	35 4	35 4	35 5	35 7	35 9	36 2	36 6	36 5	36 2	36 0	36 0	36 0	35 9	35 6	35 53
17	35 2	35 1	35 0	35 2	35 2	35 0	34 9	34 7	34 8	34 9	35 4	35 5	35 5	35 5	35 6	36 0	36 5	36 8	36 8	36 8	36 8	36 4	36 3	34 0	35 58
18	31 5	30 0	29 5	29 2	29 4	29 2	29 8	30 3	30 9	31 6	32 4	33 2	33 6	33 9	34 2	34 7	34 8	34 3	34 1	33 9	33 8	33 8	33 8	33 8	32 32
19	33 8	33 7	33 7	33 5	33 4	33 3	33 1	33 0	33 0	33 0	33 2	33 4	33 6	33 7	33 9	34 2	34 9	35 3	35 2	35 0	34 9	34 8	34 7	34 6	33 95
20	34 6	34 6	34 4	34 4	34 1	34 0	34 0	34 0	34 0	34 2	34 5	34 7	34 8	34 7	34 7	34 5	34 2	34 3	34 0	33 9	33 9	33 9	33 8	33 7	34 25
21	33 6	33 3	33 1	33 1	33 2	33 2	33 1	33 2	33 2	33 4	33 7	34 0	34 2	34 4	34 7	35 0	35 1	35 2	35 2	35 1	35 0	35 0	35 0	34 9	34 12
22	34 3	34 1	33 9	33 4	33 3	33 0	33 0	32 4	32 3	32 1	32 0	32 5	32 9	33 0	33 2	33 5	33 8	34 6	34 8	34 8	34 5	34 3	34 3	33 3	33 47
23	31 5	30 0	29 5	29 2	29 4	29 2	29 8	30 3	30 9	31 6	32 4	33 2	33 6	33 9	34 2	34 7	34 8	34 3	34 1	33 9	33 8	33 8	33 8	33 8	32 32
24	29 9	29 5	29 3	29 0	28 8	29 0	29 8	30 0	30 4	30 7	30 9	31 0	31 2	31 5	32 0	32 5	33 2	32 4	31 6	31 3	31 0	30 7	30 7	30 6	30 71
25	30 1	30 0	30 1	30 0	30 1	30 3	30 3	30 4	30 7	31 0	31 2	31 3	31 5	31 7	31 9	32 0	32 2	32 5	32 4	32 4	32 2	32 0	32 0	31 0	31 22
26	30 6	30 2	30 5	31 4	31 4	31 4	31 5	31 8	32 2	32 0	32 1	32 2	32 4	32 6	32 8	33 0	33 6	33 6	33 4	33 4	33 0	32 8	32 9	33 0	32 24
27	32 9	32 8	32 7	32 0	32 5	32 8	32 8	32 9	33 0	33 0	33 3	32 5	32 3	32 5	32 7	33 0	33 0	32 8	32 8	32 8	32 8	32 4	32 3	32 3	32 70
28	32 1	32 0	32 0	31 9	31 9	31 8	31 9	32 2	32 4	32 5	32 5	32 5	32 8	32 9	33 0	33 2	33 3	33 5	34 0	34 0	33 9	33 8	33 7	33 1	32 79
29	33 2	33 0	33 0	33 0	32 9	32 9	33 0	33 4	33 7	33 8	33 9	34 0	34 3	34 4	34 8	35 1	35 2	35 5	35 9	35 7	35 4	35 1	35 1	35 1	34 23
30	35 1	35 0	34 9	34 6	34 4	34 3	34 5	34 6	34 8	35 0	35 2	35 4	35 4	35 3	35 4	35 8	35 9	36 0	36 4	36 6	36 4	36 3	36 2	35 8	35 39

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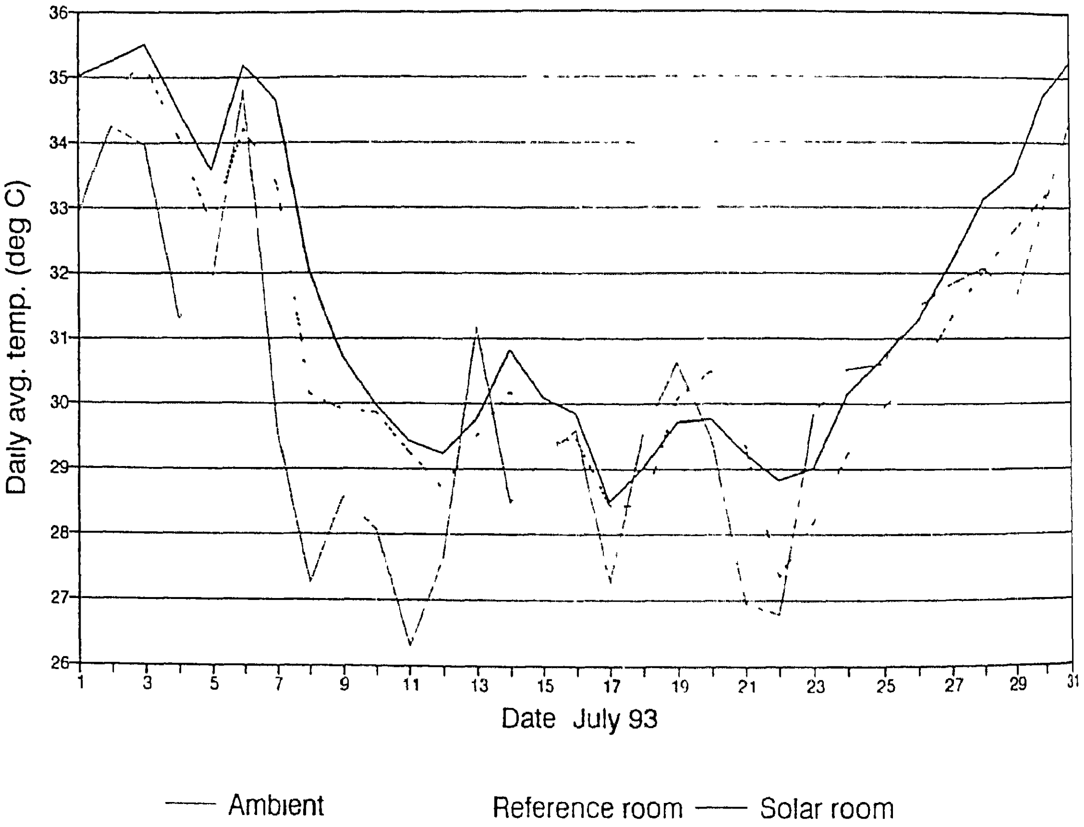

Figure: **Comparative performance monitoring of solar chimney system for July 1993**

Table: Hourly ambient temperature data for July 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	32.5	31.3	31.4	31.4	31.3	30.5	29.9	30.0	31.6	34.3	35.1	36.3	37.1	38.5	39.4	37.5	35.7	29.6	32.2	31.5	30.7	30.8	30.8	30.8	32.93
2	30.4	30.4	30.2	29.7	29.9	29.9	29.9	30.2	31.5	33.0	33.7	35.5	37.1	38.1	39.2	40.0	40.1	40.9	39.7	38.1	35.1	33.2	33.2	33.2	34.26
3	33.6	33.5	32.9	32.1	32.1	31.7	31.6	31.4	31.1	30.8	30.9	32.4	34.7	35.5	36.5	37.0	37.5	37.7	37.8	36.8	36.0	34.4	33.8	33.6	33.98
4	33.0	32.9	32.9	32.5	31.9	31.6	31.4	31.5	31.7	31.3	29.5	29.3	28.8	31.3	31.3	31.6	32.3	32.4	33.0	32.3	30.8	29.9	29.3	28.9	31.31
5	28.7	28.3	28.2	28.1	28.1	28.2	28.3	28.3	28.4	28.9	30.2	32.5	34.4	35.4	36.5	36.4	36.4	36.4	36.5	35.3	34.3	33.5	33.1	31.0	31.89
6	30.2	30.3	30.4	30.4	30.5	30.0	29.5	29.5	31.2	33.9	35.8	37.3	39.5	39.5	40.5	40.5	41.2	41.0	40.8	40.5	33.5	32.9	33.4	33.0	34.80
7	32.4	31.6	31.1	30.9	30.5	30.5	30.5	30.6	29.8	33.2	35.8	36.3	37.3	38.1	30.0	25.5	25.3	24.7	24.4	24.3	24.3	24.3	24.2	24.2	29.58
8	23.8	23.8	23.8	23.8	23.9	24.0	24.2	24.2	25.0	27.7	28.7	30.9	32.1	33.4	33.2	29.4	29.2	30.7	31.2	26.2	26.2	26.3	26.3	26.3	27.26
9	26.4	26.5	26.5	26.5	26.6	26.7	26.8	27.2	28.2	29.7	30.5	31.5	31.7	32.5	33.3	33.3	28.2	28.4	28.5	28.1	27.3	27.2	27.2	27.2	28.58
10	27.3	27.3	27.1	27.0	26.9	27.0	27.2	26.7	26.8	28.3	26.5	27.3	28.7	30.0	30.0	30.9	29.6	29.5	29.7	29.2	29.3	28.3	28.0	27.5	28.09
11	27.0	25.7	25.6	25.4	25.4	25.4	25.5	25.5	25.6	26.7	27.3	28.7	26.9	26.9	27.0	26.4	26.4	26.4	26.3	26.2	26.2	26.2	26.2	26.1	26.29
12	25.6	25.6	25.5	25.5	25.5	25.5	25.5	25.7	25.7	28.0	28.6	29.9	30.1	31.3	31.6	31.0	28.5	28.5	28.2	27.9	27.9	27.4	27.3	27.3	27.65
13	27.0	27.0	27.0	27.0	27.0	27.0	26.9	27.0	27.5	30.2	31.2	32.6	34.0	34.8	35.7	36.2	36.6	35.9	35.6	34.2	32.8	32.1	31.7	31.0	31.17
14	30.5	30.4	30.3	30.2	30.2	30.1	30.1	30.1	30.1	28.5	31.2	33.0	29.3	27.7	27.7	27.7	26.4	25.5	25.8	25.9	25.9	25.9	25.8	25.8	28.50
15	25.8	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.5	28.5	29.8	30.2	31.5	32.7	33.0	33.1	33.7	31.4	31.0	31.0	31.0	30.2	30.0	29.2	29.19
16	28.7	28.7	28.8	28.7	27.2	26.5	26.4	26.4	27.6	28.5	28.6	30.7	31.8	32.4	33.1	33.5	33.5	33.4	32.1	30.0	28.8	28.5	28.4	28.3	29.61
17	28.2	28.2	28.2	27.3	27.2	27.2	26.9	26.1	26.1	25.3	25.7	25.7	28.2	27.7	27.7	27.8	27.7	27.9	28.3	28.2	28.0	27.0	27.0	27.1	27.28
18	26.9	26.9	26.9	26.9	27.0	27.0	27.0	26.9	27.2	28.1	28.4	28.9	31.1	32.1	32.7	32.8	33.0	33.0	32.9	32.3	31.0	30.3	29.8	29.5	29.53
19	28.7	28.5	28.4	28.1	28.0	27.6	27.7	28.4	28.4	28.8	30.2	32.2	32.4	32.4	33.3	34.2	33.9	33.8	33.8	33.1	31.6	31.0	30.7	30.2	30.64
20	29.5	29.3	29.0	28.5	28.0	27.4	27.2	27.3	27.6	29.5	29.7	30.9	31.8	31.4	29.3	30.2	31.4	31.3	30.5	30.3	29.8	29.5	29.4	28.8	29.48
21	28.6	28.2	28.1	27.9	27.9	27.9	28.0	27.3	27.3	26.7	26.7	27.5	28.7	26.7	26.6	26.6	26.5	26.5	25.7	25.7	25.7	25.4	25.4	25.0	26.94
22	24.5	24.6	24.6	24.6	24.7	24.8	25.2	25.2	24.9	24.8	25.1	25.8	26.9	28.2	28.8	29.7	28.7	29.7	29.9	29.4	28.7	28.0	28.0	28.0	26.78
23	27.8	27.8	27.6	27.3	27.3	27.3	27.3	27.3	7.6	28.1	29.3	29.9	31.4	32.3	31.9	32.9	33.4	33.7	33.5	32.8	31.0	29.9	29.4	29.3	29.84
24	28.8	28.4	28.1	28.0	28.0	27.4	27.2	27.4	28.0	29.4	31.2	31.6	31.7	33.0	33.7	34.5	34.2	34.2	33.9	33.4	31.9	30.6	29.4	28.6	30.53
25	27.7	27.7	27.0	26.7	26.1	26.1	25.9	26.0	26.7	28.8	30.3	32.4	33.4	34.4	35.5	35.5	35.7	35.3	34.8	33.8	32.8	31.3	31.1	29.8	30.62
26	29.3	28.2	27.8	27.4	27.1	26.8	27.0	27.1	27.7	29.5	31.2	33.1	34.0	35.0	35.4	35.6	36.0	36.1	35.6	34.4	33.4	33.0	32.6	32.2	31.48
27	31.1	30.2	28.7	28.7	28.7	28.7	28.7	28.7	28.8	29.7	31.6	33.3	33.5	33.5	33.5	34.7	35.4	35.4	36.0	35.0	34.0	33.2	32.3	30.7	31.84
28	29.9	29.5	29.0	28.5	28.0	27.6	27.2	27.8	29.2	30.8	32.2	32.7	34.0	35.0	36.0	36.9	36.9	36.9	36.4	35.5	34.2	33.0	31.8	31.0	32.08
29	29.8	29.2	28.7	28.0	27.8	27.7	27.3	27.3	28.0	29.6	31.0	32.7	33.7	34.2	35.2	35.6	36.1	36.1	36.0	34.7	33.3	32.5	31.7	31.2	31.56
30	30.4	30.2	29.9	29.6	29.6	29.2	29.0	28.7	29.4	31.4	32.7	33.7	34.7	36.1	37.0	37.2	37.7	37.8	37.5	36.7	35.1	33.9	33.3	32.2	33.04
31	31.7	31.5	31.5	31.0	30.6	30.1	29.0	28.9	30.1	32.5	34.2	35.3	36.3	37.2	37.8	39.0	39.0	39.1	39.0	38.2	37.4	35.3	34.5	34.2	34.31

Table: Hourly reference conventional room temperature data for July 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	34.7	34.1	34.1	34.2	34.0	34.1	34.1	34.1	34.1	34.2	34.3	34.6	35.0	35.1	35.3	35.4	35.0	34.5	34.6	34.6	34.6	34.3	34.3	34.3	34.48
2	34.3	34.3	34.2	34.1	34.0	33.9	33.8	33.8	34.0	34.3	34.3	34.4	34.8	35.2	35.3	35.6	36.0	36.2	36.0	36.0	35.0	35.3	35.2	35.2	34.80
3	35.2	35.2	35.1	35.1	35.0	34.8	34.8	34.7	34.6	34.7	34.8	34.8	34.9	35.0	35.2	35.5	35.8	36.0	35.9	35.8	35.6	35.4	35.4	35.6	35.20
4	35.2	35.1	35.0	35.0	35.0	35.0	35.0	35.0	34.9	34.4	34.0	33.5	33.6	33.0	33.0	33.5	33.4	33.8	33.8	33.7	33.6	33.5	33.4	33.4	34.12
5	33.1	32.6	32.3	32.0	32.0	31.9	31.9	31.9	32.0	32.1	32.2	32.5	32.9	33.0	33.0	33.0	33.2	33.6	33.5	33.5	33.5	33.5	33.3	33.2	32.74
6	33.2	33.3	33.3	33.3	33.2	33.1	33.1	33.0	33.2	33.4	33.5	34.0	34.5	34.7	35.0	35.3	35.8	35.7	35.6	35.5	35.0	35.0	35.0	34.8	34.23
7	34.8	34.6	34.2	34.3	34.5	33.9	33.9	33.8	33.9	34.0	34.0	34.5	34.9	35.1	35.2	31.5	31.8	31.9	31.8	31.8	31.9	31.7	31.7	31.6	33.39
8	31.3	31.0	30.7	30.4	30.3	30.3	30.2	30.1	30.0	30.0	30.0	30.0	30.2	30.2	29.7	29.7	30.5	30.2	30.0	29.9	29.9	29.8	29.7	29.6	30.15
9	29.5	29.5	29.4	29.3	29.3	29.3	29.3	29.5	29.8	29.8	29.8	29.9	30.0	30.1	30.2	30.4	30.8	30.6	30.4	30.3	30.2	30.1	30.1	30.1	29.90
10	30.1	30.1	30.1	30.0	30.0	30.0	29.9	29.8	29.8	29.8	29.7	29.7	29.8	29.8	29.9	29.9	29.9	29.9	29.9	29.9	29.8	29.8	29.7	29.6	29.87
11	29.6	29.5	29.5	29.5	29.4	29.3	29.3	29.3	29.2	29.3	29.4	29.4	29.4	29.4	29.3	29.3	29.2	29.2	29.1	29.0	28.9	28.9	28.9	28.9	29.26
12	28.8	28.8	28.7	28.6	28.5	28.5	28.4	28.4	28.4	28.4	28.5	28.8	29.2	29.2	29.0	29.2	29.0	29.0	28.6	28.6	28.6	28.6	28.6	28.6	28.71
13	28.6	28.6	28.6	28.5	28.5	28.5	28.4	28.3	28.9	29.0	29.1	29.3	29.9	30.0	30.0	30.2	30.7	30.6	30.5	30.5	30.4	30.5	30.5	30.4	29.52
14	30.4	30.4	30.3	30.3	30.3	30.3	30.2	30.3	30.7	30.8	30.9	30.9	30.7	30.1	30.1	30.0	29.9	29.9	29.9	29.8	29.8	29.7	29.6	29.4	30.20
15	29.4	29.3	29.2	29.1	29.0	29.0	29.0	29.0	29.3	29.3	29.3	29.4	29.6	29.6	29.7	29.9	29.6	29.6	29.6	29.6	29.5	29.5	29.4	29.4	29.39
16	29.3	29.2	29.2	29.1	29.0	28.9	28.8	28.7	29.1	29.12	29.1	29.2	29.3	29.8	30.0	30.2	30.4	30.3	30.2	30.0	29.8	29.7	29.5	29.4	29.47
17	29.3	29.2	29.1	29.0	28.9	28.7	28.5	28.3	28.5	28.6	28.2	28.3	28.3	28.3	28.3	28.2	28.2	28.2	28.3	28.3	28.2	28.1	28.0	28.0	28.46
18	27.9	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.9	28.0	28.0	28.1	28.2	28.4	28.7	28.8	29.0	29.7	29.5	29.3	29.2	29.3	29.2	29.3	28.46
19	29.3	29.3	29.3	29.3	29.3	29.3	29.2	29.3	29.3	29.6	29.7	29.9	30.0	30.2	30.4	30.7	30.9	31.2	31.0	30.9	30.9	30.9	30.9	30.9	30.07
20	30.8	30.8	30.8	30.6	30.4	30.2	30.1	30.1	30.2	30.2	30.2	30.5	30.8	30.9	30.3	30.6	31.0	30.8	30.7	30.6	30.5	30.4	30.4	30.4	30.51
21	30.3	30.2	30.2	30.1	30.0	30.0	30.0	30.0	29.9	29.9	29.9	29.8	29.7	29.1	29.1	29.0	29.1	29.0	28.8	28.5	28.2	28.0	28.0	27.9	29.36
22	27.9	27.9	27.4	27.1	27.0	26.9	26.9	26.8	26.4	26.7	26.8	26.8	27.1	27.4	27.7	27.9	27.8	27.9	27.9	27.8	27.8	27.7	27.7	27.6	27.37
23	27.6	27.6	27.5	27.4	27.4	27.3	27.3	27.3	27.5	27.6	27.9	28.0	28.4	28.7	28.8	28.8	28.9	29.2	29.1	29.0	28.9	28.9	28.9	28.9	28.20
24	28.3	28.8	28.7	28.6	28.6	28.5	28.5	28.5	28.6	28.8	28.9	29.0	29.2	29.5	29.8	28.9	30.0	30.3	30.1	30.0	30.0	30.0	29.9	29.8	29.22
25	29.8	29.8	29.7	29.4	29.3	29.1	29.0	29.0	29.0	29.2	29.2	29.4	29.6	29.9	30.2	30.5	30.8	31.2	31.1	31.0	30.8	30.6	30.5	30.4	29.94
26	30.3	30.2	30.1	30.0	29.9	29.8	29.8	29.7	29.8	30.2	30.1	30.1	30.0	30.4	30.6	30.6	30.9	31.5	31.5	31.3	31.2	31.1	31.1	31.1	30.47
27	31.1	31.0	31.0	31.0	30.9	30.9	30.8	30.7	30.7	30.7	30.9	31.0	31.2	31.3	31.3	31.5	31.7	32.1	32.0	32.0	32.0	32.0	32.0	32.0	31.33
28	31.9	31.9	31.9	31.8	31.8	31.6	31.4	31.4	31.4	31.8	31.8	31.7	31.7	31.7	31.8	31.9	32.5	32.7	33.0	32.8	32.7	32.6	32.6	32.5	32.04
29	32.5	32.4	32.4	32.3	32.1	32.0	32.0	32.0	32.3	32.4	32.3	32.3	32.5	32.6	32.8	32.9	33.5	33.7	33.4	33.3	33.2	33.1	33.0	33.0	32.67
30	33.0	33.0	33.0	32.8	32.8	32.6	32.5	32.5	32.7	32.8	32.7	32.7	32.8	33.0	33.1	33.4	33.8	34.3	34.1	34.0	33.8	33.8	33.6	33.4	33.18
31	33.3	33.2	33.2	33.2	33.1	33.0	33.0	33.0	33.0	33.0	33.2	33.2	33.2	33.3	33.3	34.0	34.4	34.3	34.3	34.3	34.1	34.1	34.1	34.1	33.54

Table: Hourly solar chimney room temperature data for July 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	35 0	34 0	33 8	34 0	34 3	34 7	34 8	35 0	35 3	35 5	35 6	35 9	36 0	36 0	36 2	36 2	34 5	34 8	34 2	34 8	34 9	34 7	34 9	35 0	35 00
2	35 0	34 8	34 8	34 7	34 4	33 7	34 1	34 7	35 0	35 2	35 2	35 3	35 3	35 5	36 0	36 3	36 6	36 9	36 5	36 4	35 2	34 8	34 6	34 8	35 24
3	35 0	34 8	34 9	34 9	34 2	33 7	34 7	35 0	35 0	35 0	35 2	35 5	35 8	35 9	36 1	36 4	36 6	36 8	36 6	36 4	36 1	35 8	35 8	35 6	35 49
4	35 2	35 0	34 8	34 7	34 7	34 6	34 7	35 3	35 5	35 0	34 7	34 2	34 5	34 7	35 0	35 0	35 1	34 2	34 3	34 1	33 9	33 4	33 1	32 9	34 53
5	32 6	32 1	32 3	31 8	31 5	31 6	31 8	32 5	32 8	33 0	33 5	33 8	34 0	34 2	34 4	34 6	35 0	35 2	35 2	35 1	35 0	35 0	34 6	34 5	33 59
6	34 6	34 7	34 7	34 5	34 3	34 5	34 6	34 7	34 9	35 0	35 0	35 0	35 0	35 1	35 3	35 5	36 0	35 8	36 0	35 8	36 0	36 0	35 9	35 5	35 18
7	35 2	34 9	34 6	34 5	34 5	34 5	34 2	34 2	34 0	34 0	34 0	34 0	34 2	34 3	34 5	34 7	34 8	35 0	35 0	35 1	35 2	35 3	35 4	35 4	34 65
8	31 8	31 6	31 3	31 0	30 8	30 5	30 3	30 2	30 6	31 0	31 4	31 7	31 9	32 4	32 6	33 3	33 4	33 5	33 5	33 4	33 4	33 3	33 1	33 0	32 04
9	29 8	29 8	29 8	29 7	29 0	29 3	29 8	30 8	31 2	31 3	31 3	32 0	32 5	32 4	32 4	32 6	32 9	31 5	30 0	29 8	29 8	29 8	29 9	29 8	30 72
10	29 6	29 4	29 3	29 3	28 5	29 0	29 7	29 9	30 0	30 1	30 2	30 5	30 6	30 7	30 8	30 9	30 9	31 0	30 8	30 0	29 9	29 7	29 6	29 3	29 99
11	28 7	28 4	28 4	28 4	28 5	28 5	29 0	29 5	29 9	30 0	30 3	30 5	30 7	30 7	30 4	30 3	30 2	29 5	29 8	29 5	29 1	29 0	28 8	28 6	29 45
12	28 4	28 3	28 1	28 0	28 0	27 8	27 5	27 2	27 4	28 1	28 5	28 9	29 7	30 4	30 6	31 4	31 6	31 4	31 0	30 5	30 0	30 0	29 7	29 5	29 25
13	29 4	29 1	28 7	28 5	28 2	28 3	28 8	29 3	29 5	29 6	29 8	30 0	30 2	30 4	30 8	31 0	31 0	30 9	30 8	30 6	30 3	30 0	29 8	29 6	29 78
14	30 0	30 6	30 8	30 8	31 0	31 2	31 3	31 5	31 9	32 0	32 1	32 0	31 8	31 6	31 4	31 3	29 0	29 5	30 0	30 0	30 0	30 0	30 0	30 0	30 83
15	29 8	29 6	29 6	29 4	29 5	29 3	29 5	29 7	30 0	30 2	30 3	30 3	30 4	30 5	30 6	31 0	30 5	30 5	30 5	30 5	30 5	30 1	30 0	30 0	30 10
16	30 0	30 0	30 0	28 4	28 6	28 4	29 3	29 5	30 0	30 0	30 1	30 1	30 3	30 4	30 7	31 0	31 0	31 2	30 6	30 0	29 6	29 3	29 0	28 8	29 85
17	28 6	28 2	28 1	28 0	28 0	28 0	28 0	28 4	28 7	28 8	28 9	29 0	29 1	29 3	29 2	29 2	29 0	28 9	28 9	28 3	28 1	28 0	27 8	28 0	28 52
18	28 3	28 4	28 1	28 1	28 0	28 0	27 8	27 7	27 4	27 6	28 2	28 7	29 2	29 9	30 0	30 4	30 6	30 6	30 2	30 0	30 0	30 0	29 9	29 6	29 03
19	29 4	29 2	29 0	28 9	28 8	28 8	28 9	29 0	29 3	29 4	29 5	29 6	29 9	30 2	30 5	30 8	30 9	30 8	30 4	30 2	30 0	30 0	29 9	29 8	29 72
20	29 4	29 1	28 7	28 5	28 2	28 3	28 8	29 3	29 5	29 6	29 8	30 0	30 2	30 4	30 8	31 0	31 0	30 9	30 8	30 6	30 3	30 0	29 8	29 6	29 78
21	28 4	28 3	28 1	28 0	28 0	27 8	27 5	27 2	27 4	28 1	28 5	28 9	29 7	30 4	30 6	31 4	31 6	31 4	31 0	30 5	30 0	30 0	29 7	29 5	29 25
22	28 8	28 6	28 4	28 3	28 1	28 0	27 9	28 0	28 3	28 4	28 5	28 6	29 0	29 5	29 6	29 7	29 7	29 9	29 8	29 4	29 0	29 0	28 6	28 7	28 83
23	28 3	28 4	28 1	28 1	28 0	28 0	27 8	27 7	27 4	27 6	28 2	28 7	29 2	29 9	30 0	30 4	30 6	30 6	30 2	30 0	30 0	30 0	29 9	29 6	29 03
24	30 0	29 9	29 5	29 2	29 0	28 8	28 5	28 6	28 7	28 8	29 0	29 2	29 5	30 6	31 0	31 7	32 1	32 0	31 8	31 5	31 5	31 4	30 9	30 4	30 15
25	29 9	29 5	29 3	29 0	28 8	29 0	29 8	30 0	30 4	30 7	30 9	31 0	31 2	31 5	32 0	32 5	33 2	32 4	31 6	31 3	31 0	30 7	30 7	30 6	30 71
26	30 4	30 2	30 0	29 7	29 5	30 0	30 4	30 8	30 9	30 9	31 0	31 2	31 5	31 8	32 1	32 4	32 7	32 9	32 3	32 1	32 0	32 0	31 9	31 8	31 27
27	31 7	31 5	31 4	31 2	31 2	31 1	31 3	31 5	31 7	31 9	32 0	32 1	32 2	32 4	32 8	33 0	33 2	33 4	33 1	32 9	32 8	32 7	32 6	32 5	32 18
28	32 3	32 2	32 1	32 0	31 9	31 7	32 0	32 3	32 5	32 6	32 6	32 8	32 9	33 0	33 4	33 8	34 3	35 0	35 0	34 7	34 3	34 0	33 9	33 7	33 13
29	33 6	32 8	32 8	33 0	33 0	32 4	32 5	32 0	32 8	33 0	33 6	33 5	33 4	33 6	33 8	34 0	34 5	34 7	34 9	34 5	34 3	34 1	33 9	33 9	33 53
30	33 9	33 8	33 7	33 5	33 6	33 4	33 3	33 3	33 5	33 8	34 0	34 0	34 5	35 2	35 8	36 3	36 7	36 8	36 5	36 0	35 7	35 4	35 2	35 2	34 71
31	35 0	34 8	34 8	34 7	34 4	33 7	34 1	34 7	35 0	35 2	35 2	35 3	35 3	35 5	36 0	36 3	36 6	36 9	36 5	36 4	35 2	34 8	34 6	34 8	35 24

August 1993

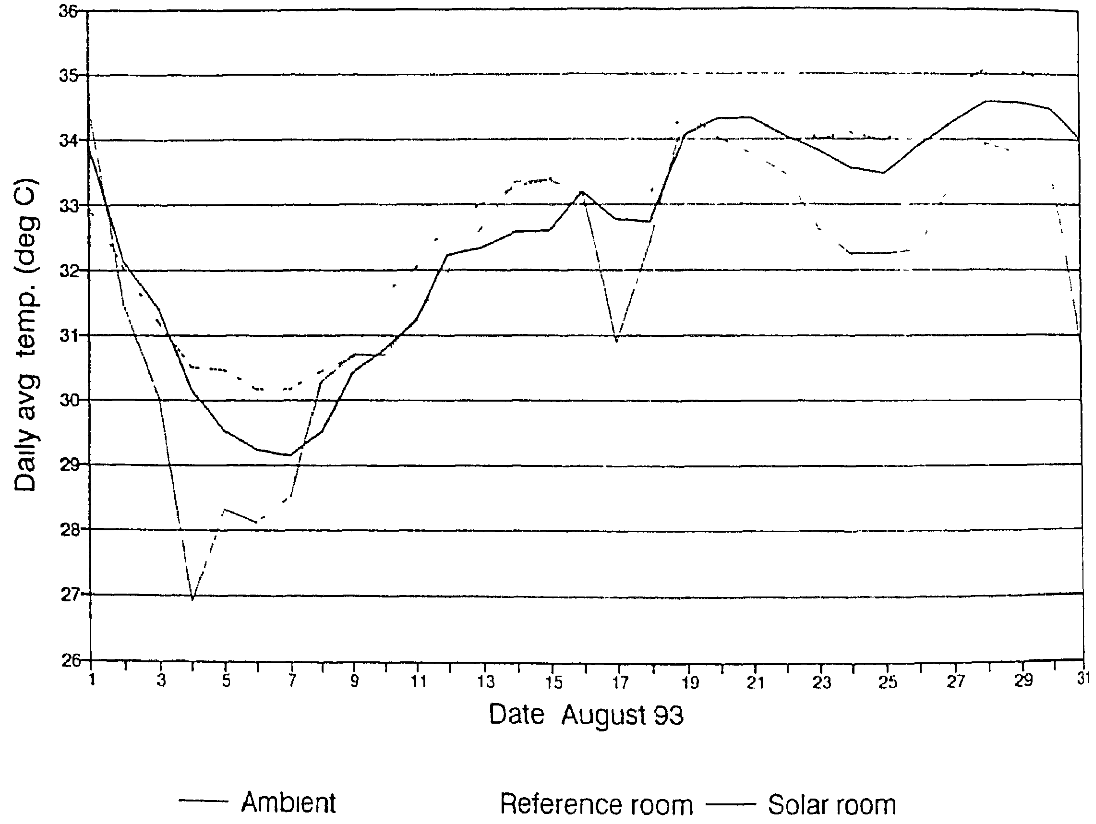

Figure: **Comparative performance monitoring of solar chimney system for August 1993**

Table: Hourly ambient temperature data for August 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	33.9	33.6	33.2	32.3	32.0	31.5	30.8	30.5	31.0	32.6	33.6	34.7	36.0	37.0	37.8	38.1	38.2	38.8	39.0	37.5	36.1	34.6	34.1	31.5	34.52
2	30.3	30.1	30.1	29.8	29.5	29.5	29.4	28.6	28.6	30.0	30.8	30.2	33.9	34.0	34.9	35.1	35.0	33.7	33.7	33.3	32.1	31.4	30.6	30.2	31.45
3	29.6	29.4	28.8	28.5	28.5	28.4	28.4	28.4	29.0	30.5	32.0	30.5	30.1	30.6	30.4	30.4	30.6	31.2	31.7	31.7	31.2	30.7	30.3	30.2	30.05
4	29.5	29.5	29.5	29.5	29.5	28.0	25.7	25.7	25.0	24.3	24.5	25.0	24.8	24.7	24.7	25.7	25.7	26.6	28.4	28.2	27.7	27.8	27.8	27.9	26.90
5	27.9	27.6	27.7	27.7	27.8	27.8	27.9	27.9	27.9	27.3	27.3	27.5	28.0	29.5	29.9	29.5	29.3	29.3	29.1	29.0	28.8	28.6	28.4	28.3	28.33
6	28.2	28.3	28.3	28.3	27.4	27.0	27.0	27.0	27.0	26.2	26.3	26.4	28.1	28.7	29.4	31.4	31.1	29.5	29.0	28.5	28.3	27.8	27.8	27.8	28.12
7	27.5	27.5	27.5	27.4	27.0	26.9	26.9	27.0	27.4	28.2	24.7	30.8	32.0	32.5	32.4	32.4	28.3	28.1	28.4	28.6	28.6	28.6	28.3	28.0	28.54
8	27.2	27.1	27.1	27.0	26.7	26.8	26.8	27.5	28.6	29.2	30.3	31.4	32.7	33.6	34.1	34.7	34.7	34.7	33.8	32.5	30.9	30.3	29.8	29.5	30.29
9	28.8	28.8	28.8	28.3	28.1	28.2	27.6	27.6	28.0	29.0	29.9	30.8	32.2	33.3	34.1	34.5	35.1	34.4	33.4	32.7	31.8	31.2	30.3	29.8	30.70
10	29.4	29.1	28.6	27.7	27.1	27.0	26.9	26.9	27.9	29.2	30.7	32.0	32.5	33.7	34.1	35.0	35.0	35.0	34.2	32.8	31.9	31.0	30.0	29.1	30.70
11	28.25	27.8	27.2	27.0	26.6	26.6	26.5	26.7	27.7	29.8	32.0	33.2	34.4	35.7	35.9	36.5	36.4	36.4	36.1	34.1	33.0	32.1	30.3	29.5	31.24
12	28.9	28.9	28.9	28.8	28.7	28.2	28.1	28.1	29.2	30.6	31.9	33.7	34.4	35.4	36.7	36.9	37.1	36.9	34.5	33.9	33.0	32.4	31.5	30.5	31.97
13	29.5	28.9	28.5	27.5	27.2	27.0	26.5	27.0	28.7	31.3	33.4	35.1	35.9	36.5	37.2	38.1	38.1	38.1	37.5	36.6	35.6	34.1	33.4	31.6	32.64
14	31.2	31.1	30.5	30.1	29.6	29.0	28.7	28.7	29.4	31.2	33.0	34.6	35.5	36.4	37.4	38.0	38.2	38.2	38.0	36.7	35.1	33.7	33.3	32.5	33.34
15	32.4	31.5	31.0	30.5	29.3	28.5	28.0	28.0	28.7	31.5	32.9	34.1	36.7	37.4	37.4	37.5	37.5	37.5	37.5	36.3	35.3	34.5	33.8	33.0	33.37
16	31.9	31.5	31.0	30.6	30.4	30.0	29.5	29.5	30.3	31.0	33.0	34.4	35.0	36.1	36.5	37.0	37.0	37.1	36.5	35.9	34.6	33.4	32.3	31.5	33.17
17	30.4	30.0	29.5	29.5	29.5	29.5	29.5	29.5	30.7	30.5	30.3	30.4	32.3	33.4	33.9	33.9	33.1	33.0	32.4	31.3	30.4	29.9	29.3	29.3	30.90
18	29.0	29.0	28.8	28.5	28.4	28.4	28.3	28.2	29.4	30.5	32.7	34.2	35.3	36.1	35.0	35.7	36.3	36.5	35.0	35.3	35.8	35.6	33.8	32.6	32.43
19	32.0	31.6	31.2	30.8	30.3	30.2	29.9	29.7	30.0	32.4	34.1	36.0	37.3	38.4	39.3	39.3	39.4	39.4	39.0	38.0	36.0	34.5	33.5	33.0	34.39
20	31.7	31.0	30.4	30.0	29.8	29.8	29.8	29.8	30.5	33.1	34.4	35.2	36.5	37.4	38.2	38.3	38.5	38.5	38.0	37.1	35.4	34.9	34.5	33.3	34.00
21	32.8	32.8	32.4	31.5	30.3	29.6	29.6	29.8	31.0	32.4	33.8	35.2	36.3	36.7	37.5	37.8	37.8	37.7	37.2	35.8	34.5	33.6	32.2	32.0	33.76
22	31.6	30.9	30.6	30.5	30.3	29.7	29.3	29.3	30.8	31.5	32.4	33.6	36.9	36.8	37.8	38.4	38.3	38.3	37.4	35.9	34.9	33.7	32.6	31.7	33.47
23	30.9	30.9	30.0	30.0	29.4	28.9	28.6	28.9	29.8	30.8	32.3	33.4	34.9	35.8	36.3	37.1	37.3	37.5	36.8	35.0	33.3	32.3	31.3	31.3	32.62
24	30.3	29.7	28.6	28.3	28.0	27.4	26.8	28.9	29.0	32.0	33.5	34.4	34.9	35.9	36.3	37.0	37.4	37.3	36.7	35.0	33.4	32.4	31.5	31.0	32.24
25	30.1	29.9	29.4	29.0	28.6	27.5	26.9	26.9	28.5	30.7	32.4	33.7	34.8	35.9	37.0	37.3	37.4	37.0	36.4	35.4	33.9	33.3	31.4	30.4	32.24
26	29.8	29.2	28.7	28.4	28.4	28.0	27.9	27.9	28.7	30.8	32.7	34.0	35.6	36.0	37.1	36.7	36.7	36.8	36.2	35.2	33.7	32.6	32.1	32.0	32.30
27	31.4	30.7	30.2	30.0	29.6	29.4	29.2	29.2	29.7	31.3	33.0	34.7	35.8	37.0	37.0	37.3	37.2	37.1	37.1	36.3	35.4	34.7	34.0	33.0	33.35
28	31.8	31.1	30.4	29.8	29.3	29.0	28.7	28.7	26.5	32.3	34.7	36.0	37.5	38.0	38.9	39.3	39.4	39.1	38.4	37.3	35.5	34.5	33.4	32.0	33.94
29	31.6	31.5	31.4	30.8	30.4	29.2	29.0	29.0	2[illegible].2	31.2	33.7	35.4	36.9	37.8	38.0	38.1	38.5	38.4	37.7	36.2	35.5	35.0	33.5	33.0	33.79
30	32.5	32.0	31.5	31.2	30.0	29.2	29.3	29.3	29.6	31.4	33.4	34.7	35.4	36.4	37.3	37.4	37.4	37.4	36.9	36.0	35.4	34.3	33.4	32.3	33.49
31	31.4	30.8	30.5	30.4	30.3	30.1	30.1	29.9	30.4	31.4	31.9	32.5	32.9	33.4	33.4	32.8	32.4	32.0	30.8	30.0	28.9	28.0	27.8	27.5	30.82

Table: Hourly reference conventional room temperature data for August 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	32.3	32.3	32.0	32.0	32.0	32.0	32.0	32.2	32.6	32.8	32.6	32.7	32.8	32.9	33.0	33.3	33.6	33.9	34.0	34.0	34.0	34.0	34.0	33.9	32.95
2	31.9	31.9	31.9	31.8	31.8	31.6	31.4	31.4	31.4	31.8	31.8	31.7	31.7	31.7	31.8	31.9	32.5	32.7	33.0	32.8	32.7	32.6	32.6	32.5	32.04
3	31.2	31.2	31.1	31.0	30.9	30.8	30.6	30.5	30.3	30.3	30.5	30.8	31.5	31.2	31.1	31.2	31.3	31.6	32.0	32.0	31.9	31.9	31.9	31.9	31.20
4	30.8	30.8	30.8	30.6	30.4	30.2	30.1	30.1	30.2	30.2	30.2	30.5	30.8	30.9	30.3	30.6	31.0	30.8	30.7	30.6	30.5	30.4	30.4	30.4	30.51
5	30.3	30.2	30.1	30.0	29.9	29.8	29.8	29.7	29.8	30.2	30.1	30.1	30.0	30.4	30.6	30.6	30.9	31.5	31.5	31.3	31.2	31.1	31.1	31.1	30.47
6	31.3	31.0	30.7	30.4	30.3	30.3	30.2	30.1	30.0	30.0	30.0	30.0	30.2	30.2	29.7	29.7	30.5	30.2	30.0	29.9	29.9	29.8	29.7	29.9	30.17
7	31.3	31.0	30.7	30.4	30.3	30.3	30.2	30.1	30.0	30.0	30.0	30.0	30.2	30.2	29.7	29.7	30.5	30.2	30.0	29.9	29.9	29.8	29.7	29.9	30.17
8	30.3	30.2	30.1	30.0	29.9	29.8	29.8	29.7	29.8	30.2	30.1	30.1	30.0	30.4	30.6	30.6	30.9	31.5	31.5	31.3	31.2	31.1	31.1	30.9	30.46
9	30.4	30.3	30.2	30.1	29.9	29.9	29.8	29.8	30.1	30.2	30.3	30.4	30.7	31.0	31.0	31.0	32.0	31.5	31.3	31.3	31.2	31.2	31.2	31.0	30.66
10	31.0	31.0	31.0	31.0	31.0	30.9	30.9	30.9	31.1	31.2	31.3	31.4	31.7	31.8	32.0	32.1	32.6	32.4	32.3	32.3	32.3	32.3	32.3	32.3	31.63
11	31.9	31.9	31.9	31.8	31.8	31.6	31.4	31.4	31.4	31.8	31.8	31.7	31.7	31.7	31.8	31.9	32.5	32.7	33.0	32.8	32.7	32.6	32.6	32.5	32.04
12	33.1	32.6	32.3	32.0	32.0	31.9	31.9	31.9	32.0	32.1	32.2	32.5	32.9	33.0	33.0	33.0	33.2	33.6	33.5	33.3	33.2	33.2	33.0	32.9	32.68
13	32.8	32.5	32.3	32.0	32.1	32.0	32.0	32.2	32.6	32.8	32.6	32.7	32.8	32.9	33.0	33.3	33.6	33.9	34.0	34.0	34.0	34.0	34.0	33.9	33.00
14	33.6	33.0	33.0	32.8	32.8	32.6	32.5	32.5	32.7	32.8	32.7	32.7	32.8	33.0	33.1	33.4	33.8	34.3	34.1	34.0	34.0	34.0	34.0	34.0	33.26
15	33.7	33.6	33.5	33.4	33.2	32.9	32.6	32.1	32.0	32.2	32.4	32.7	33.0	33.3	33.6	33.7	34.1	34.6	34.5	34.2	33.9	33.9	33.9	33.9	33.37
16	33.8	33.8	33.7	33.6	33.5	33.4	33.2	33.0	33.1	33.2	33.2	33.3	33.5	33.6	33.9	34.3	34.5	35.0	34.8	34.6	34.5	34.4	34.4	34.3	33.86
17	34.1	34.0	33.9	33.8	33.8	33.7	33.7	33.6	33.6	33.3	33.0	32.9	33.0	33.3	33.5	33.5	33.5	33.7	33.6	33.6	33.4	33.3	33.2	33.1	33.50
18	33.0	33.0	32.9	32.8	32.7	32.6	32.4	32.3	32.3	32.4	32.5	32.6	32.8	33.3	33.4	33.5	33.7	34.0	33.8	33.9	33.8	33.6	33.8	33.7	33.12
19	33.8	33.9	33.6	33.2	33.1	33.3	33.7	33.8	33.8	33.9	34.0	34.7	35.0	35.8	36.0	36.1	35.7	35.3	35.3	35.1	35.1	35.1	35.0	35.0	34.55
20	34.9	34.8	34.6	34.0	33.8	33.3	33.3	33.4	33.6	34.1	34.5	35.0	35.3	35.7	36.0	35.8	35.6	35.5	35.4	35.2	35.2	35.2	35.2	35.0	34.77
21	34.9	34.9	34.7	34.4	33.8	33.5	33.6	33.7	33.9	34.0	34.6	34.9	35.0	35.6	35.9	36.0	35.8	35.6	35.3	35.0	34.8	34.9	34.9	34.5	34.76
22	34.1	34.0	34.0	33.1	32.9	32.8	32.8	33.0	33.3	33.6	33.9	34.7	35.0	35.5	35.8	35.9	35.9	35.8	35.7	35.2	35.0	34.9	34.8	34.4	34.41
23	34.5	34.2	33.6	33.0	32.8	32.4	32.6	32.6	32.8	33.1	33.7	34.0	34.3	35.0	35.3	35.7	35.3	35.0	34.5	34.4	34.3	34.3	34.2	34.1	33.99
24	34.0	34.0	34.0	33.6	33.2	33.0	32.7	32.5	32.9	33.2	33.4	33.9	34.5	35.0	35.2	35.3	35.2	35.1	35.0	34.9	34.8	34.4	34.5	34.5	34.12
25	34.2	34.0	33.6	33.6	33.5	33.4	33.0	32.8	32.9	33.0	33.2	33.6	33.9	34.3	34.8	35.0	35.1	34.9	34.8	34.5	34.4	34.3	34.3	34.2	33.97
26	34.1	34.0	34.2	34.3	34.0	33.9	33.8	33.9	33.8	33.8	33.8	33.9	33.9	34.0	34.2	34.4	34.9	35.2	35.1	35.0	35.0	34.7	34.8	34.8	34.31
27	34.9	34.8	34.6	34.7	34.6	34.5	34.2	34.1	34.0	34.0	34.0	34.0	34.2	34.4	34.6	34.9	35.4	35.5	35.9	35.6	35.6	35.5	35.3	35.2	34.77
28	35.2	35.3	35.2	35.3	35.2	35.0	34.8	34.6	34.2	34.0	34.1	34.3	34.5	34.6	34.6	34.9	35.2	35.3	35.6	36.1	36.0	35.9	35.9	35.8	35.07
29	35.9	35.6	35.7	35.5	35.3	35.1	35.0	34.7	34.6	34.3	34.1	34.0	34.3	34.5	34.6	34.8	34.9	35.0	35.3	35.5	35.9	35.9	35.7	35.6	35.08
30	35.4	35.4	35.2	35.2	35.3	35.1	35.0	34.7	34.5	34.4	34.2	34.2	34.1	34.1	34.1	34.5	34.9	34.8	35.0	35.2	35.1	35.2	35.3	35.3	34.84
31	35.2	35.1	35.0	35.0	35.0	35.0	34.9	34.6	34.4	34.3	34.2	34.1	34.3	34.6	34.5	34.5	34.5	34.3	34.3	34.2	34.0	33.9	33.6	33.5	34.46

Table: Hourly solar chimney room temperature data for August 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	33 2	32 8	32 6	32 8	33 2	33 3	33 1	33 1	33 4	33 6	33 7	33 8	33 8	34 0	34 2	34 4	35 0	35 2	35 2	35 3	34 6	34 4	34 3	34 1	33 88
2	32 6	32 4	32 3	32 0	32 0	31 7	31 5	31 4	31 5	31 6	31 6	31 6	31 6	31 7	31 8	32 3	33 0	32 8	32 7	32 5	32 6	32 6	32 6	32 5	32 12
3	31 4	31 3	31 3	31 2	31 1	31 1	31 0	30 8	30 6	30 5	30 6	30 8	31 0	31 3	31 5	31 6	31 7	31 8	32 0	32 2	32 3	32 3	32 1	31 9	31 39
4	30 0	29 9	29 5	29 2	29 0	28 8	28 5	28 6	28 7	28 8	29 0	29 2	29 5	30 6	31 0	31 7	32 1	32 0	31 8	31 5	31 5	31 4	31 1	30 9	30 18
5	30 4	30 4	30 5	30 4	30 0	29 9	29 9	29 9	30 0	29 8	29 7	29 7	29 2	28 6	28 2	28 5	29 1	29 3	29 1	29 3	29 4	29 5	29 2	28 8	29 53
6	28 4	28 3	28 1	28 0	28 0	27 8	27 5	27 2	27 4	28 1	28 5	28 9	29 7	30 4	30 6	31 4	31 6	31 4	31 0	30 5	30 0	30 0	29 7	29 5	29 25
7	29 1	28 6	28 4	28 5	28 6	28 6	28 6	28 6	29 0	29 2	29 4	29 6	29 8	29 9	29 9	29 7	29 3	29 4	29 5	29 4	29 3	29 2	29 1	29 1	29 16
8	28 9	28 7	28 6	28 5	28 4	28 3	28 2	28 5	28 8	29 0	29 3	29 4	29 6	29 9	29 9	30 1	30 4	30 6	30 7	30 7	30 5	30 4	30 4	30 3	29 50
9	30 3	30 3	30 2	30 1	30 0	29 7	29 3	29 3	29 8	30 0	30 1	30 1	30 2	30 4	30 5	30 7	31 0	31 0	31 2	31 3	31 3	31 3	31 1	31 0	30 43
10	31 0	30 9	30 8	30 5	30 2	30 0	30 0	29 8	30 1	30 4	30 7	30 7	30 8	31 0	31 0	31 2	31 4	31 6	31 7	31 4	31 2	31 1	31 0	30 7	30 80
11	30 6	30 3	30 2	30 1	30 0	30 0	29 9	30 0	30 5	30 8	31 0	31 1	31 2	31 4	31 7	31 9	32 0	32 5	32 7	32 5	32 3	32 3	32 1	32 0	31 21
12	32 0	31 9	31 8	31 7	31 5	31 4	31 6	31 7	31 7	31 8	32 0	32 2	32 5	32 8	33 0	33 0	32 9	33 0	32 8	32 8	32 8	32 5	32 1	31 8	32 22
13	31 5	31 5	31 4	31 3	31 2	31 1	31 3	31 6	31 8	32 0	32 3	32 5	32 7	32 9	33 1	33 4	33 7	33 5	33 2	33 0	32 8	32 8	32 8	32 7	32 34
14	32 6	32 4	32 2	31 9	31 5	31 1	31 5	31 7	32 0	32 2	32 4	32 6	32 9	33 1	33 3	33 6	33 6	33 6	33 5	33 2	33 0	32 8	32 7	32 6	32 58
15	32 4	32 2	32 1	31 9	31 6	31 4	31 3	31 8	32 0	32 2	32 4	32 6	32 8	33 0	33 1	33 3	33 5	33 8	33 6	33 4	33 0	33 1	33 1	33 0	32 61
16	32 9	32 9	32 9	32 8	32 7	32 6	32 5	32 8	32 8	32 9	32 9	33 0	33 2	33 4	33 6	33 7	33 9	33 9	33 9	33 8	33 4	33 3	33 4	33 4	33 19
17	33 3	33 2	33 2	33 2	33 1	33 0	33 0	33 1	33 1	33 1	33 1	33 1	33 0	33 0	33 1	33 1	33 1	33 0	32 3	31 8	31 4	31 5	31 8	31 9	32 77
18	32 0	32 0	32 0	32 0	32 0	31 9	31 9	32 0	32 3	32 5	32 5	32 6	32 7	32 7	32 8	33 0	33 3	33 8	34 1	34 0	33 8	33 6	33 1	33 0	32.73
19	33 3	33 4	33 1	33 1	33 1	33 0	32 9	32 8	32 9	33 0	32 2	33 3	33 5	34 2	35 0	35 5	35 9	36 2	36 3	35 7	35 2	34 6	34 7	34 7	34 07
20	34 7	34 2	34 0	33 7	33 6	33 6	33 5	33 3	33 4	33 6	33 8	33 9	34 0	34 2	34 4	34 8	34 9	35 0	35 3	35 4	35 3	35 0	34 9	34 9	34 31
21	34 9	34 7	34 7	34 6	34 2	34 1	33 7	33 2	33 1	33 2	33 3	33 5	34 0	34 3	34 3	34 5	34 9	34 9	35 0	35 2	35 3	35 0	34 5	34 5	34 32
22	34 4	34 0	33 8	33 6	33 5	33 5	33 2	33 0	32 9	32 7	33 2	33 3	33 3	33 6	34 0	34 2	34 5	34 5	35 2	35 7	35 8	35 6	35 1	34 5	34 05
23	34 4	34 3	34 3	34 0	33 9	33 7	33 2	32 7	32 5	32 4	32 7	33 1	33 3	33 4	33 5	34 0	34 0	34 0	34 2	34 9	35 3	35 0	34 6	34.2	33 82
24	34 0	33 9	33 6	33 4	33 5	33 3	33 1	33 1	32 8	32 3	32 4	32 9	33 0	33 1	33 1	33 5	33 8	34 0	34 1	34 3	34 2	34 8	34 8	34 3	33 55
25	34 3	34 1	33 9	33 4	33 3	33 0	33 0	32 4	32 3	32 1	32 0	32 5	32 9	33 0	33 2	33 5	33 8	34 6	34 8	34 8	34 5	34 3	34 3	33 3	33 47
26	33 2	32 8	32 8	32 8	33 2	33 3	33 1	33 1	33 4	33 6	33 7	33 8	33 8	34 0	34 2	34 4	35 0	35 2	35 2	35 3	34 6	34 4	34 3	34 1	33 88
27	33 9	34 0	33 9	33 7	33 6	33 4	33 1	33 0	33 4	33 9	34 0	34 0	34 2	34 4	34 4	34 7	34 9	35 1	35 2	35 7	35 5	35 2	34 8	34 4	34 27
28	34 6	34 7	34 4	34 2	33 9	33 7	33 5	33 2	33 3	33 8	34 1	34 2	34 5	34 7	34 8	34 9	35 0	35 2	35 4	35 9	35 9	35 6	35 2	35 0	34 57
29	34 6	34 5	34 1	34 2	34 1	34 1	34 1	34 1	33 8	33 8	34 0	33 9	34 0	34 2	34 4	34 6	34 8	35 1	35 2	35 4	35 9	35 9	35 3	35 2	34 55
30	35 0	34 9	34 6	34 5	34 0	34 0	34 1	33 8	33 8	33 7	33 6	33 9	34 0	34 1	34 3	34 6	34 7	34 8	35 0	35 2	35 3	35 3	35 1	35 0	34 47
31	35 0	34 9	34 4	34 3	34 3	34 1	34 0	34 0	33 8	33 7	33 3	33 8	34 0	34 3	34 2	34 2	34 2	34 4	34 3	34 4	34 3	33 3	32 9	32 0	34 00

September 1993

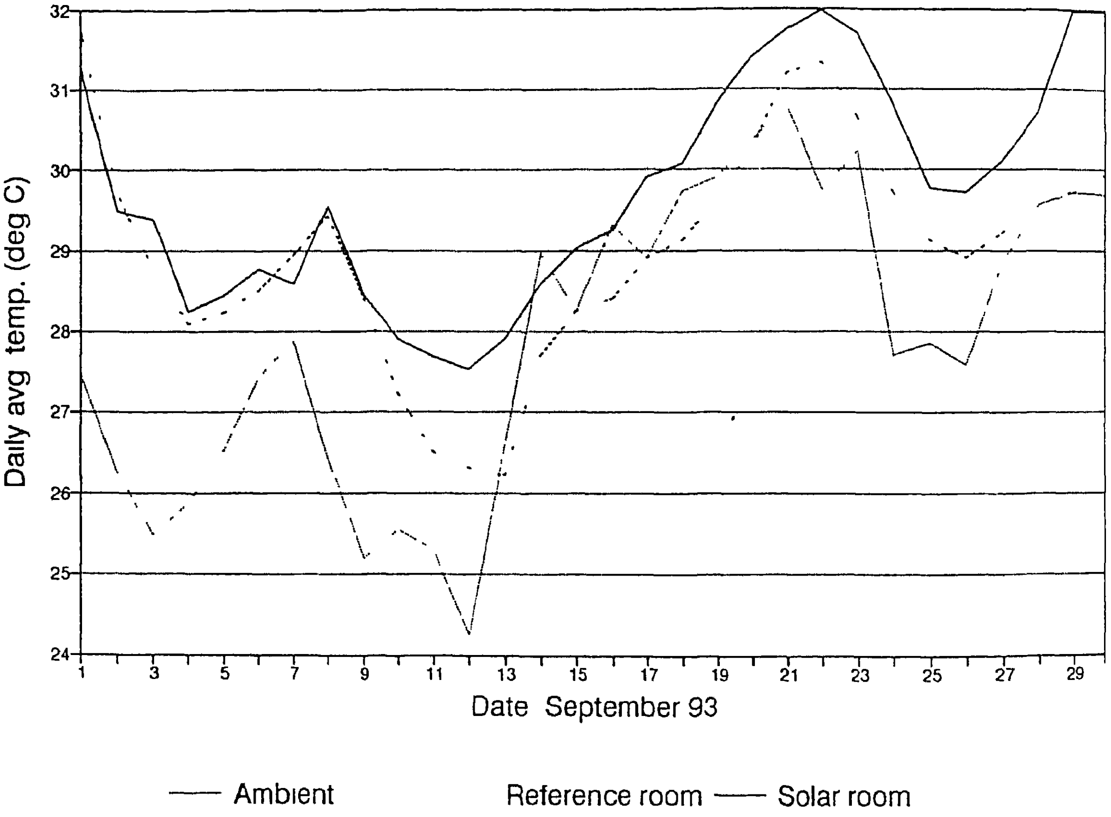

Figure: **Comparative performance monitoring of solar chimney system for September 1993**

Table: Hourly ambient temperature data for September 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	27.3	27.1	27.0	26.9	26.6	26.6	26.6	26.6	26.9	28.1	29.1	29.0	29.0	27.8	28.0	27.8	28.1	28.1	27.8	27.6	27.2	27.0	26.6	26.6	27.48
2	26.0	25.8	25.7	25.5	25.4	25.4	25.3	25.1	25.0	25.2	25.3	25.6	26.2	28.0	29.2	29.9	29.8	26.0	25.9	26.0	26.0	26.0	26.0	25.6	26.25
3	25.3	25.2	25.2	25.1	25.1	25.1	24.3	24.3	24.3	26.0	26.1	26.5	28.1	26.0	25.2	25.1	25.2	25.2	25.7	25.7	25.8	25.8	25.7	25.7	25.49
4	26.1	26.1	26.1	26.0	25.8	25.8	25.7	25.7	25.7	25.6	25.6	25.6	26.2	26.3	27.1	27.1	27.1	26.6	26.2	26.2	24.6	24.6	24.6	24.6	25.88
5	25.1	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.1	25.4	24.9	25.0	25.7	26.4	27.4	29.1	30.0	30.5	30.2	28.2	27.4	26.9	26.4	26.4	26.52
6	26.3	26.3	26.3	26.2	26.2	26.2	25.9	25.9	25.9	26.1	27.0	27.6	28.7	29.5	30.2	31.1	30.8	30.0	28.6	27.6	27.1	26.6	26.3	25.8	27.43
7	25.6	25.3	25.3	25.3	25.3	25.2	25.2	25.2	25.2	25.3	26.1	27.5	29.0	30.3	31.5	31.6	31.6	31.6	31.5	30.1	29.5	29.1	28.6	28.2	27.88
8	27.7	27.6	27.6	27.2	26.9	26.6	26.6	26.6	27.2	26.4	23.8	24.0	23.6	24.4	26.6	28.1	28.3	28.7	27.4	26.3	26.0	25.7	25.5	25.5	26.43
9	25.3	25.3	25.4	25.5	25.5	25.6	25.6	25.0	25.0	24.7	24.8	24.5	24.9	25.0	25.2	25.4	25.4	25.3	25.4	25.4	25.4	25.3	25.0	25.0	25.20
10	24.9	24.9	24.9	25.0	25.1	25.1	25.1	25.2	25.2	25.7	25.7	27.1	27.4	29.2	29.1	29.7	24.7	24.4	24.2	24.2	24.2	24.1	24.1	24.1	25.55
11	24.1	24.2	24.2	24.3	24.4	24.4	24.7	24.9	24.9	25.7	25.7	25.8	26.9	27.6	27.3	26.9	26.3	25.2	25.1	25.1	25.1	24.9	24.7	24.7	25.30
12	24.4	24.3	24.3	24.2	24.2	24.3	24.4	24.4	24.4	24.2	24.2	24.2	24.4	24.4	24.5	24.7	24.6	24.2	23.9	23.8	23.7	23.5	25.4	23.4	24.25
13	23.1	23.1	22.9	22.9	23.0	22.9	22.9	22.9	23.2	24.1	26.5	28.0	29.4	30.0	30.6	30.5	30.2	31.2	30.6	29.9	28.3	27.5	27.2	27.1	26.58
14	26.3	25.8	25.6	25.5	25.2	25.0	24.6	24.6	25.6	27.5	29.6	30.2	31.3	32.2	33.6	33.6	33.6	33.6	33.0	31.6	30.3	29.5	28.8	28.5	28.96
15	28.1	27.6	27.2	27.1	26.8	26.7	26.8	22.8	23.1	22.8	24.4	27.7	29.9	31.1	32.1	32.8	32.8	32.5	31.9	30.4	29.2	28.4	27.9	27.8	28.25
16	27.3	27.0	26.9	26.3	25.9	25.7	25.4	25.3	26.3	28.3	30.1	31.0	31.9	32.7	33.1	33.3	33.3	33.1	32.5	31.5	30.4	29.4	28.7	28.2	29.32
17	27.8	27.5	27.2	27.1	26.4	26.5	26.3	26.2	26.6	29.2	28.8	29.6	30.7	30.6	30.7	30.9	31.0	31.3	31.3	31.2	30.1	29.4	28.8	28.4	28.90
18	27.5	27.4	27.3	27.0	26.7	26.6	26.5	26.5	26.8	27.5	28.8	30.6	32.0	32.4	33.5	33.3	33.8	33.8	33.2	32.6	31.1	30.1	29.6	29.1	29.74
19	28.6	28.1	28.0	28.0	27.7	27.6	27.5	27.5	28.1	30.7	31.4	32.6	32.7	33.3	33.6	33.9	34.2	29.3	29.3	29.8	29.2	29.1	29.1	29.0	29.92
20	28.7	28.2	27.9	27.5	27.2	27.1	26.9	26.8	28.0	29.9	30.9	31.9	33.1	33.4	33.6	33.8	33.8	33.7	33.4	32.0	31.2	30.5	29.9	29.4	30.37
21	28.6	28.4	28.2	27.7	27.4	27.0	26.7	26.7	28.3	30.2	32.1	33.3	33.9	34.1	34.6	34.7	34.7	34.5	34.0	32.5	31.6	30.7	30.1	29.2	30.80
22	28.1	27.8	27.5	27.2	27.2	27.1	27.0	26.7	27.0	28.5	29.8	30.9	32.0	33.0	33.0	33.5	33.4	32.7	32.3	31.0	30.2	29.5	29.4	29.0	29.74
23	28.4	28.3	27.8	27.5	27.3	26.8	26.4	26.3	27.2	29.9	31.4	32.4	32.9	32.4	33.9	34.1	33.7	33.4	32.5	31.6	31.1	30.4	30.0	29.7	30.23
24	29.0	28.0	28.2	27.8	27.5	27.3	26.9	26.7	26.9	29.1	28.1	23.9	23.9	26.1	28.5	29.7	29.7	29.5	29.3	28.7	28.0	27.7	27.5	27.1	27.71
25	26.8	26.6	26.2	25.8	25.3	24.8	24.8	24.8	24.8	25.4	27.0	28.7	29.5	30.9	30.8	31.1	31.2	31.1	30.6	29.9	29.0	28.5	28.0	27.0	27.86
26	26.2	25.9	25.7	25.4	25.6	25.4	25.4	25.0	25.1	26.0	26.4	27.1	29.3	30.3	30.8	30.8	30.9	30.8	30.4	29.1	28.4	27.9	27.4	27.1	27.60
27	26.8	26.4	26.0	25.9	25.7	25.7	25.5	25.5	27.2	28.8	30.4	30.2	31.1	31.9	32.0	32.4	32.1	32.1	32.0	31.0	29.5	28.7	28.2	27.6	28.86
28	26.8	26.6	26.4	26.0	25.9	25.9	25.8	25.7	26.9	29.3	30.7	31.9	33.0	33.0	33.9	32.7	33.4	33.4	32.5	31.9	30.6	30.0	29.3	28.0	29.57
29	27.4	27.0	26.4	26.2	25.5	25.3	25.3	25.3	26.2	28.8	30.3	31.8	32.4	33.4	35.0	34.7	34.8	34.1	33.3	32.1	31.1	29.7	28.8	28.3	29.72
30	27.1	26.8	26.1	25.9	25.7	25.3	24.7	24.6	25.2	27.9	30.4	32.0	33.4	34.9	34.8	34.9	35.4	34.6	33.2	32.3	30.9	30.2	28.7	27.5	29.69

Table: Hourly reference conventional room temperature data for September 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	33 2	32 8	32 5	32 4	32 4	32 4	32 6	32 7	32 6	32 4	32 1	31 8	31 6	31 3	31 4	31 3	31 1	31 0	30 8	30 9	31 1	31 0	30 8	30 2	31 77
2	30 0	30 0	29 7	29 5	29 3	29 3	29 4	29 3	29 3	29 4	29 5	29 6	29 8	30 1	30 2	30 0	30 1	30 0	30 0	29 9	29 9	29 6	29 5	29 7	29 71
3	29 5	29 4	29 7	29 7	29 4	29 0	28 9	29 0	29 2	29 4	29 5	29 3	28 5	28 3	28 2	28 4	28 2	28 2	28 0	28 1	28 0	28 0	28 0	28 0	28 75
4	28 1	28 1	28 0	28 0	28 0	28 0	27 9	27 8	27 9	27 9	27 9	28 0	28 1	28 2	28 1	28 3	28 5	28 2	28 3	28 4	28 2	28 1	28 0	28 0	28 08
5	28 0	28 0	28 0	28 0	27 9	28 0	28 1	28 2	28 1	28 0	28 1	28 0	28 1	28 1	28 2	28 6	28 9	28 7	28 5	28 4	28 4	28 4	28 3	28 3	28 22
6	28 2	28 1	28 1	28 0	28 1	28 1	28 2	28 3	28 2	28 3	28 2	28 2	28 3	28 7	28 6	28 6	28 8	28 9	29 0	29 0	29 0	29 0	29 1	29 1	28 50
7	29 0	29 0	28 9	28 8	28 6	28 5	28 3	28 3	28 4	28 4	28 4	28 6	28 5	28 7	28 9	29 1	29 2	29 3	29 5	29 6	29 6	29 5	29 7	29 8	28 94
8	29 7	29 8	29 8	29 8	29 7	29 7	29 7	29 7	29 5	29 4	29 4	29.3	29 1	29 0	29 0	29 1	29 2	29 3	29 8	29 5	29 6	29 4	29 2	29 1	29 43
9	29 0	28 9	28 8	28 7	28 7	28 6	28 6	28 5	28 5	28 4	28 4	28 3	28 3	28 2	28 1	28 2	28 2	28 3	28 4	28 5	28 2	28 0	28 0	27 9	28 40
10	27 8	27 6	27 6	27 5	27 5	27 6	27 5	27 5	27 4	27 4	27 3	27 3	27 1	27 1	27 2	27 2	27 3	27 4	27 3	26 9	26 6	26 6	26 5	26 3	27 23
11	26 2	26 1	26 0	26 1	26 3	26 3	26 4	26 3	26 3	26 3	26 3	26 4	26 3	26 5	26 7	26 8	26 9	26 9	27 0	27 0	26 9	26 8	26 8	26 7	26 51
12	26 7	26 6	26 6	26 4	26 6	26 7	26 5	26 5	26 4	26 3	26 2	26 2	26 1	26 1	26 0	26 0	26 1	26 2	26 2	26 3	26 2	26 3	26 2	26 2	26 32
13	26 1	26 1	26 1	26 1	26 1	26 1	26 0	26 0	25 8	25 5	25 4	25 4	25 5	25 6	26 2	26 4	26 4	26 4	26 7	26 9	27 0	27 2	27 1	27 2	26 22
14	27 2	27 2	27 1	27 1	27 1	27 2	27 2	27 1	27 0	27 0	27 0	27 1	27 1	27 3	28 2	28 1	28 1	28 2	28 2	28 4	29 0	29 4	29 1	28 8	27 72
15	28 5	28 4	28 3	28 2	28 0	27 9	27 7	27 6	27 7	27 8	27 7	27 7	27 7	27 8	27 9	28 4	28 7	28 8	28 8	28 8	28 9	28 9	28 9	28 9	28 25
16	29 0	28 9	28 8	28 7	28 7	28 6	28 6	28 5	28 5	28 4	28 4	28 3	28 3	28 2	28 1	28 2	28 2	28 3	28 4	28 5	28 2	28 0	28 0	27 9	28 40
17	29 1	29 1	29 0	29 0	28 9	28 8	28 7	28 6	28 6	28 7	28 8	28 9	28 9	28 8	28 9	28 9	29 0	29 0	29 0	29 0	29 0	29 0	29 0	29 0	28 90
18	29 0	28 9	28 9	28 8	28 8	28 7	28 6	28 5	28 5	28 6	28 7	29 3	29 1	29 0	29 0	29 2	29 4	29 6	29 7	29 8	29 7	29 8	29 8	29 8	29 13
19	29 8	29 8	29 8	29 7	29 6	29 5	29 4	29 3	29 2	29 4	29 6	30 5	30 0	29 8	29 8	29 8	29 8	29 8	29 7	29 6	29 4	29 3	29 2	29 1	29 62
20	29 0	28 9	28 9	29 0	29 1	29 3	29 3	29 3	29 4	29 9	30 3	30 8	31 0	30 7	30 7	30 8	30 9	31 2	31 5	31 4	31 3	31 3	31 2	31 2	30 27
21	31 2	31 2	31 1	31 0	30 9	30 8	30 6	30 5	30 3	30 3	30 5	30 8	31 5	31 2	31 1	31 2	31 3	31 6	32 0	32 0	31 9	31 9	31 9	31 9	31 20
22	31 1	31 0	31 0	31 0	30 9	30 9	30 8	30 7	30 7	30 7	30 9	31 0	31 2	31 3	31 3	31 5	31 7	32 1	32 0	32 0	32 0	32 0	32 0	32 0	31 33
23	30 4	30 3	30 2	30 1	29 9	29 9	29 8	29 8	30 1	30 2	30 3	30 4	30 7	31 0	31 0	31 0	32 0	31 5	31 3	31 3	31 2	31 2	31 2	31 0	30 66
24	30 0	30 0	29 7	29 5	29 3	29 3	29 4	29 3	29 3	29 4	29 5	29 6	29 8	30 1	30 2	30 0	30 1	30 0	30 0	29 9	29 9	29 6	29 5	29 7	29 71
25	29 0	28 9	28 9	28 8	28 8	28 7	28 6	28 5	28 5	28 6	28 7	29 3	29 1	29 0	29 0	29 2	29 4	29 6	29 7	29 8	29 7	29 8	29 8	29 8	29 13
26	29 1	29 1	29 0	29 0	28 9	28 8	28 7	28 6	28 6	28 7	28 8	28 9	28 9	28 8	28 9	28 9	29 0	29 0	29 0	29 0	29 0	29 0	29 0	29 0	28 90
27	28 3	28 8	28 7	28 6	28 6	28 5	28 5	28 5	28 6	28 8	28 9	29 0	29 2	29 5	29 8	28 9	30 0	30 3	30 1	30 0	30 0	30 0	29 9	29 8	29 22
28	30 0	30 0	29 7	29 5	29 3	29 3	29 4	29 3	29 3	29 4	29 5	29 6	29 8	30 1	30 2	30 0	30 1	30 0	30 0	29 9	29 9	29 6	29 5	29 7	29 71
29	30 0	30 0	29 7	29 5	29 3	29 3	29 4	29 3	29 3	29 4	29 5	29 6	29 8	30 1	30 2	30 0	30 1	30 0	30 0	29 9	29 9	29 6	29 5	29 7	29 71
30	29 8	29 8	29 7	29 4	29 3	29 1	29 0	29 0	29 0	29 2	29 2	29 4	29 6	29 9	30 2	30 5	30 8	31 2	31 1	31 0	30 8	30 6	30 5	30 4	29 94

Table: Hourly solar chimney room temperature data for September 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	31.0	31.0	31.0	31.1	30.8	30.6	30.3	30.9	31.0	31.3	31.0	31.2	31.5	31.9	32.0	32.0	32.0	32.1	32.0	31.9	31.8	31.3	30.6	30.3	31.28
2	30.0	29.8	29.7	29.5	29.2	29.0	29.0	29.2	29.3	29.6	29.8	29.9	30.0	30.0	30.0	30.0	30.0	29.6	29.4	29.3	29.0	28.7	28.9	29.0	29.50
3	28.9	28.8	28.8	28.7	28.8	28.6	28.8	28.9	28.9	29.0	29.0	28.9	29.0	29.5	30.0	30.3	30.5	30.4	30.3	30.1	30.0	29.9	29.8	29.5	29.39
4	29.3	29.2	28.9	28.6	28.3	28.1	28.0	28.0	27.8	27.7	27.4	27.5	27.8	28.0	28.3	28.5	28.8	28.7	29.0	28.6	28.0	27.8	27.7	27.8	28.24
5	27.7	27.8	27.8	28.0	28.1	28.1	28.0	28.3	28.3	28.3	28.0	28.1	28.1	28.2	28.4	28.4	28.6	28.7	29.2	29.5	29.5	29.4	29.2	28.8	28.44
6	28.6	28.3	28.1	28.0	28.0	28.0	28.0	28.1	28.1	28.0	28.0	28.1	28.2	28.4	28.8	29.0	29.4	29.6	30.2	30.7	30.5	30.0	29.4	29.0	28.77
7	29.0	28.8	28.6	28.1	27.9	27.7	27.8	27.9	27.6	27.2	27.2	27.2	27.4	28.0	28.8	28.8	29.0	29.3	29.5	29.6	30.0	30.3	30.2	30.2	28.59
8	30.4	30.4	30.5	30.4	30.0	29.9	29.9	29.9	30.0	29.8	29.7	29.7	29.2	28.6	28.2	28.5	29.1	29.3	29.1	29.3	29.4	29.5	29.4	29.0	29.55
9	28.8	28.9	29.0	29.0	28.9	29.0	28.9	28.8	28.8	28.8	28.7	28.5	28.3	28.3	28.1	28.0	28.1	28.0	28.0	28.0	27.8	27.6	27.9	28.5	28.45
10	27.0	27.0	26.9	26.8	26.7	26.6	26.4	26.3	26.2	26.3	27.3	29.0	30.2	30.6	29.6	29.4	29.3	29.0	28.7	28.4	28.2	28.1	28.0	27.9	27.91
11	27.2	27.0	27.0	26.8	26.5	26.3	26.0	26.0	25.8	25.9	26.0	27.5	28.6	29.0	29.5	30.2	30.0	30.0	29.5	28.5	28.0	28.0	27.8	27.6	27.70
12	27.7	27.6	27.4	27.3	27.2	27.1	27.0	26.6	26.6	26.8	27.5	28.6	27.6	27.4	27.6	27.8	28.0	28.0	28.0	27.9	27.8	27.8	27.8	27.8	27.54
13	27.0	27.0	26.9	26.8	26.7	26.6	26.4	26.3	26.2	26.3	27.3	29.0	30.2	30.6	29.6	29.4	29.3	29.0	28.7	28.4	28.2	28.1	28.0	27.9	27.91
14	29.0	28.8	28.6	28.1	27.9	27.7	27.8	27.9	27.6	27.2	27.2	27.2	27.4	28.0	28.8	28.8	29.0	29.3	29.5	29.6	30.0	30.3	30.2	30.2	28.59
15	28.3	28.4	28.1	28.1	28.0	28.0	27.8	27.7	27.4	27.6	28.2	28.7	29.2	29.9	30.0	30.4	30.6	30.6	30.2	30.0	30.0	30.0	29.9	29.6	29.03
16	28.4	28.3	28.1	28.0	28.0	27.8	27.5	27.2	27.4	28.1	28.5	28.9	29.7	30.4	30.6	31.4	31.6	31.4	31.0	30.5	30.0	30.0	29.7	29.5	29.25
17	30.1	30.0	29.9	29.8	29.7	29.6	29.5	29.2	29.3	29.5	29.7	29.9	30.0	30.0	30.0	30.1	30.2	30.3	30.4	30.4	30.2	30.1	30.0	30.0	29.91
18	29.9	29.8	29.7	29.6	29.5	29.4	29.3	29.2	29.2	29.3	29.5	29.7	30.0	30.1	30.2	30.4	30.6	30.8	31.0	31.1	31.1	31.0	30.8	30.6	30.08
19	30.5	30.4	30.3	30.2	30.1	30.0	30.0	30.0	29.9	29.9	30.0	30.5	31.0	31.0	31.1	31.2	31.3	31.5	31.8	32.0	31.9	31.8	31.6	31.5	30.81
20	31.4	31.3	31.3	31.2	31.1	31.1	31.0	30.8	30.6	30.5	30.6	30.8	31.0	31.3	31.5	31.6	31.7	31.8	32.0	32.2	32.3	32.3	32.1	31.9	31.39
21	31.8	31.7	31.6	31.4	31.1	31.0	30.9	30.8	30.7	30.6	30.6	31.0	31.4	31.7	32.0	32.0	32.2	32.4	32.6	32.8	33.0	32.9	32.8	32.6	31.73
22	32.4	32.2	32.0	31.8	31.7	31.6	31.4	31.3	31.1	31.0	31.0	31.2	31.5	31.6	31.7	32.0	32.3	32.5	32.8	32.9	33.0	33.0	32.8	32.7	31.98
23	32.4	32.3	32.2	32.0	31.8	31.7	31.4	31.4	31.3	31.1	30.9	31.0	31.3	31.7	31.8	32.3	32.2	32.2	32.1	32.0	31.6	31.4	31.3	31.1	31.69
24	31.0	30.9	30.8	30.7	30.6	30.8	31.0	31.3	31.0	30.0	30.2	30.6	30.9	31.2	31.6	31.5	32.3	31.1	31.0	30.7	30.6	30.3	30.0	29.7	30.83
25	29.4	29.1	28.7	28.5	28.2	28.3	28.8	29.3	29.5	29.6	29.8	30.0	30.2	30.4	30.8	31.0	31.0	30.9	30.8	30.6	30.3	30.0	29.8	29.6	29.78
26	29.4	29.2	29.0	28.9	28.8	28.8	28.9	29.0	29.3	29.4	29.5	29.6	29.9	30.2	30.5	30.8	30.9	30.8	30.4	30.2	30.0	30.0	29.9	29.8	29.72
27	29.8	29.6	29.4	29.3	29.2	29.1	29.1	29.3	29.6	29.8	30.0	30.1	30.3	30.5	30.8	31.0	31.0	30.9	30.9	30.9	30.8	30.6	30.4	30.3	30.11
28	29.9	29.5	29.3	29.0	28.8	29.0	29.8	30.0	30.4	30.7	30.9	31.0	31.2	31.5	32.0	32.5	33.2	32.4	31.6	31.3	31.0	30.7	30.7	30.6	30.71
29	32.0	31.9	31.8	31.7	31.6	31.5	31.5	31.3	31.3	31.2	31.3	31.3	31.4	31.6	32.0	32.2	32.3	32.5	32.7	32.8	32.8	32.8	32.9	32.9	31.97
30	32.0	31.9	31.8	31.7	31.6	31.5	31.5	31.3	31.3	31.2	31.3	31.3	31.4	31.6	32.0	32.2	32.3	32.5	32.7	32.8	32.8	32.8	32.9	32.9	31.97

October 1993

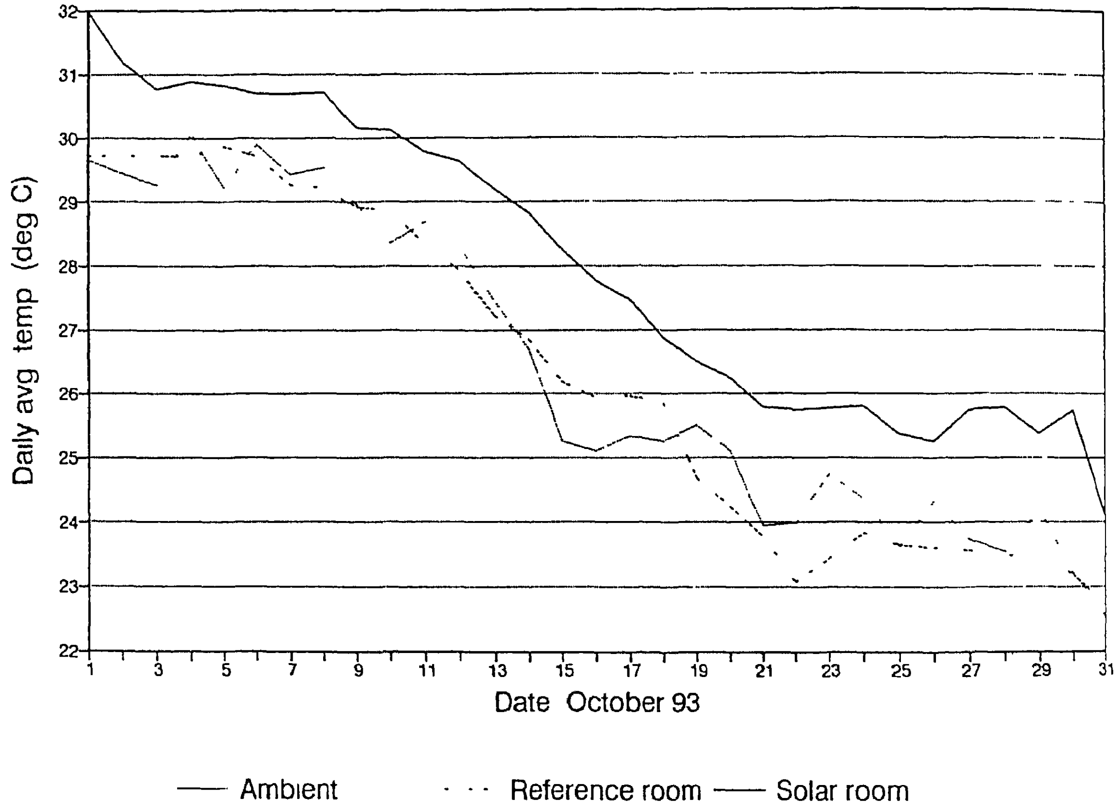

Figure: Comparative performance monitoring of solar chimney system for October 1993

Table: Hourly ambient temperature data for October 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	26 9	26 0	25 1	24 9	24 8	24 2	24 3	24 8	26 6	30 2	30 8	32 8	34 1	34 9	36 1	36 9	35 4	34 7	33 2	30 8	30 2	28 4	27 9	27 8	29 68
2	26 7	25 3	25 2	25 1	24 8	24 8	24 7	24 7	25 0	28 4	30 5	31 9	32 7	34 1	35 4	35 2	35 1	34 7	33 0	31 9	30 4	30 2	29 4	27 5	29 45
3	26 8	26 1	26 2	25 4	24 0	24 0	24 1	24 2	24 9	27 3	30 0	31 9	33 8	34 7	35 2	35 2	35 1	34 6	33 4	31 0	29 6	28 8	28 3	27 7	29 26
4	26 8	26 3	26 0	25 8	25 4	25 3	25 2	25 2	26 1	27 2	29 3	31 3	32 8	34 2	35 0	36 3	36 3	35 6	34 3	33 1	37 7	30 5	28 8	27 2	30 07
5	26 2	25 9	25 1	24 9	24 3	23 7	23 3	23 3	24 6	26 6	29 2	31 5	32 8	34 5	35 7	35 8	36 5	35 1	34 0	32 4	30 6	29 2	28 3	27 8	29 22
6	27 0	26 5	25 4	25 0	24 7	24 4	24 4	24 3	25 0	27 1	30 1	33 0	34 8	36 2	36 5	36 9	36 7	36 0	34 4	33 1	31 1	29 2	28 1	27 5	29 89
7	26 0	25 3	25 0	24 6	24 5	24 1	23 1	23 5	24 6	26 9	29 7	32 6	34 6	36 5	36 5	36 5	36 5	36 1	34 1	31 6	29 6	28 9	28 6	27 1	29 44
8	26 6	25 6	25 0	24 1	24 0	23 7	23 4	23 4	23 8	26 5	29 4	32 7	33 8	35 2	36 2	36 6	36 6	36 0	34 7	34 4	32 4	29 0	28 0	27 7	29 53
9	26 8	25 7	25 2	24 4	23 7	23 7	23 7	23 7	25 0	25 7	29 7	31 7	33 7	34 7	34 7	34 8	34 8	34 0	33 6	32 2	30 7	29 2	27 3	26 4	28 96
10	25 0	25 8	23 6	23 4	22 7	22 6	22 4	22 0	22 2	25 4	28 5	30 9	32 6	34 5	35 2	35 2	35 2	35 2	33 6	31 7	30 6	28 2	27 2	27 0	28 36
11	26 7	26 0	25 5	24 9	24 6	24 5	24 1	24 1	25 5	28 1	30 3	32 0	33 8	33 8	33 8	33 8	33 8	33 3	31 4	30 0	27 4	27 4	27 2	26 8	28 70
12	25 4	24 8	24 2	23 9	23 0	22 4	21 5	21 5	22 5	27 1	29 0	31 1	32 7	33 9	35 3	35 2	34 9	34 3	33 0	31 8	29 7	28 3	27 5	26 3	28 30
13	26 0	25 4	24 0	23 5	23 2	23 0	21 8	21 8	22 0	24 8	27 3	29 0	30 8	32 3	32 9	33 3	33 4	33 2	31 9	30 2	29 4	27 4	26 2	26 2	27 46
14	24 8	23 1	23 1	22 4	21 4	20 9	20 5	20 4	20 5	23 1	26 2	28 6	31 2	33 3	34 1	34 9	34 6	34 0	31 2	29 7	28 2	26 2	25 1	23 2	26 70
15	21 9	21 6	21 3	20 9	20 3	20 0	19 1	19 1	19 2	21 5	25 6	28 0	30 2	31 6	33 5	33 5	33 3	32 0	30 6	28 1	25 0	24 0	23 4	22 5	25 26
16	21 9	21 0	20 8	20 4	20 0	18 9	18 4	18 4	18 9	20 6	24 4	26 9	29 5	31 2	32 2	32 3	32 7	32 6	31 2	29 2	27 4	26 6	24 1	23 2	25 12
17	22 6	21 7	21 5	21 2	20 2	19 7	18 8	18 8	18 8	21 3	25 0	28 3	30 8	32 1	32 5	32 5	32 8	32 7	31 3	27 6	26 0	24 8	23 7	23 4	25 34
18	22 3	21 3	20 6	20 1	19 3	19 2	19 3	19 3	19 4	21 5	25 1	28 5	30 6	32 5	32 5	32 6	32 6	32 3	30 1	27 5	25 3	24 8	25 0	24 5	25 26
19	21 6	21 5	20 7	20 0	19 6	19 0	19 0	19 0	20 0	22 2	25 8	29 3	31 6	32 6	33 1	33 1	33 1	31 6	29 3	27 5	26 6	26 1	24 9	25 0	25 51
20	23 4	22 7	22 0	20 8	20 3	20 0	19 7	19 4	19 9	22 8	26 0	29 8	29 9	30 8	31 3	31 8	31 8	30 8	29 7	26 2	25 4	24 9	22 1	21 2	25 11
21	21 1	20 2	19 5	19 2	18 1	16 7	15 8	15 8	17 0	20 5	24 5	27 1	29 2	30 5	31 5	31 6	31 5	30 4	29 3	27 1	26 1	25 6	24 7	22 0	23 96
22	21 9	21 7	18 9	18 1	17 9	17 2	16 5	16 7	17 8	20 7	24 6	26 9	28 7	30 0	30 4	31 0	31 0	30 8	28 7	27 2	25 8	25 4	24 2	23 4	23 98
23	22 2	22 0	22 0	21 2	21 1	20 4	20 2	20 2	20 2	22 1	25 6	28 0	29 0	29 6	30 5	30 7	30 3	29 5	27 4	25 8	25 2	24 1	23 5	23 3	24 75
24	21 8	20 5	20 6	20 1	20 1	19 8	19 0	19 4	19 4	22 8	25 4	27 5	28 4	29 3	30 0	30 1	30 1	29 9	28 5	27 4	26 3	24 4	23 3	21 3	24 39
25	20 8	19 9	19 3	18 7	18 0	17 7	17 2	17 2	18 0	21 0	24 0	26 7	29 3	29 4	30 0	30 7	30 7	30 2	28 3	25 7	25 0	23 7	23 1	22 6	23 63
26	21 7	21 3	20 5	20 0	21 2	21 0	20 1	19 3	19 7	20 4	23 9	26 0	28 5	29 5	30 6	31 0	31 0	30 6	28 4	27 3	25 4	22 9	22 0	21 3	24 32
27	20 7	19 9	19 0	18 7	17 8	16 4	15 8	15 7	16 1	20 3	23 9	26 7	29 2	30 1	31 2	31 6	31 6	30 7	29 7	28 1	27 2	25 2	22 4	21 6	23 73
28	20 8	20 3	18 6	17 9	17 6	17 4	17 4	17 5	18 2	20 9	24 1	26 6	28 3	30 0	30 6	31 4	31 9	30 6	26 9	25 0	24 3	23 5	23 2	22 4	23 56
29	21 0	21 0	20 2	20 1	19 4	18 8	18 4	18 4	18 7	21 9	26 0	28 7	29 4	29 8	29 9	29 9	29 8	29 5	28 6	26 1	24 9	24 7	23 6	21 8	24 19
30	21 4	20 6	20 0	17 4	17 4	17 0	16 7	16 8	17 3	20 6	24 1	26 6	27 5	28 8	29 1	30 2	30 1	29 8	28 0	26 5	25 2	22 9	22 0	21 0	23 21
31	20 0	19 2	18 5	18 3	17 7	17 5	17 2	17 0	16 9	18 7	21 9	26 0	27 0	28 0	28 8	29 0	29 0	28 6	26 6	24 5	23 8	23 0	21 6	21 6	22 52

Table: Hourly reference conventional room temperature data for October 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	30.0	30.0	29.7	29.5	29.3	29.3	29.4	29.3	29.3	29.4	29.5	29.6	29.8	30.1	30.2	30.0	30.1	30.0	30.0	29.9	29.9	29.6	29.5	29.7	29.71
2	30.0	30.0	29.7	29.5	29.3	29.3	29.4	29.3	29.3	29.4	29.5	29.6	29.8	30.1	30.2	30.0	30.1	30.0	30.0	29.9	29.9	29.6	29.5	29.7	29.71
3	30.0	30.0	29.7	29.5	29.3	29.3	29.4	29.3	29.3	29.4	29.5	29.6	29.8	30.1	30.2	30.0	30.1	30.0	30.0	29.9	29.9	29.6	29.5	29.7	29.71
4	30.0	30.0	29.7	29.5	29.3	29.3	29.4	29.3	29.3	29.4	29.5	29.6	29.8	30.1	30.2	30.0	30.1	30.0	30.0	29.9	29.9	29.6	29.5	29.7	29.71
5	30.1	30.1	30.1	30.0	30.0	30.0	29.9	29.8	29.8	29.8	29.7	29.7	29.8	29.8	29.9	29.9	29.9	29.9	29.9	29.9	29.8	29.8	29.7	29.6	29.87
6	30.0	30.0	29.7	29.5	29.3	29.3	29.4	29.3	29.3	29.4	29.5	29.6	29.8	30.1	30.2	30.0	30.1	30.0	30.0	29.9	29.9	29.6	29.5	29.7	29.71
7	29.6	29.5	29.5	29.5	29.4	29.3	29.3	29.3	29.2	29.3	29.4	29.4	29.4	29.4	29.3	29.3	29.2	29.2	29.1	29.0	28.9	28.9	28.9	28.9	29.26
8	28.3	28.8	28.7	28.6	28.6	28.5	28.5	28.5	28.6	28.8	28.9	29.0	29.2	29.5	29.8	28.9	30.0	30.3	30.1	30.0	30.0	30.0	29.9	29.8	29.22
9	29.4	29.1	29.0	29.0	28.9	28.8	28.7	28.6	28.6	28.7	28.8	28.9	28.9	28.8	28.9	28.9	29.0	29.0	29.0	29.0	29.0	29.0	29.0	29.0	28.92
10	29.0	29.0	28.9	28.8	28.6	28.5	28.3	28.3	28.4	28.4	28.4	28.6	28.5	28.7	28.9	29.1	29.2	29.3	29.5	29.6	29.6	29.5	29.0	28.6	28.86
11	28.2	28.1	28.1	28.0	28.1	28.1	28.2	28.3	28.2	28.3	28.2	28.2	28.3	28.7	28.6	28.6	28.8	28.9	28.8	28.6	28.3	28.0	28.6	28.1	28.35
12	27.8	27.8	27.7	27.6	27.5	27.4	27.2	27.2	27.3	27.3	27.2	27.2	27.4	27.6	27.9	28.4	28.9	29.0	28.7	28.6	28.6	28.6	28.6	28.6	27.92
13	27.8	27.6	27.6	27.5	27.5	27.6	27.5	27.5	27.4	27.4	27.3	27.3	27.1	27.1	27.2	27.2	27.3	27.4	27.3	26.9	26.6	26.6	26.5	26.3	27.23
14	26.9	26.8	26.7	26.6	26.4	26.3	26.0	26.0	26.4	26.4	26.2	26.4	26.8	26.9	27.0	27.0	27.5	27.7	27.5	27.6	27.6	27.4	27.3	27.0	26.85
15	26.7	26.5	26.5	26.3	26.1	26.1	26.0	26.0	25.8	25.5	25.4	25.4	25.5	25.6	26.2	26.4	26.4	26.4	26.7	26.9	27.0	26.7	26.4	26.2	26.20
16	26.0	25.9	25.8	25.7	25.5	25.4	25.2	25.4	25.3	25.4	25.4	25.3	25.4	25.5	25.6	25.9	26.4	26.9	26.7	26.7	26.8	26.9	26.7	26.5	25.93
17	26.1	25.9	25.8	25.7	25.5	25.4	25.2	25.4	25.3	25.4	25.4	25.3	25.4	25.5	25.6	25.9	26.4	26.9	26.7	26.7	26.8	26.9	26.9	27.0	25.96
18	26.0	25.9	25.8	25.7	25.5	25.4	25.2	25.4	25.3	25.4	25.4	25.3	25.4	25.5	25.6	25.9	26.4	26.9	26.7	26.7	26.8	26.4	26.1	25.7	25.85
19	25.2	24.8	24.7	24.7	24.7	24.6	24.3	24.1	24.1	24.2	24.3	24.6	24.5	24.4	24.8	25.0	25.3	25.2	25.0	25.0	24.8	24.7	25.0	24.5	24.69
20	24.3	24.3	24.2	24.1	24.0	24.0	23.8	23.7	23.5	23.5	23.5	23.6	23.8	24.3	24.7	25.0	25.0	24.9	24.8	24.7	24.7	24.6	24.5	24.4	24.25
21	24.1	24.1	24.0	24.0	23.9	23.7	23.6	23.5	23.3	23.3	23.4	23.6	23.5	23.5	23.7	24.1	24.0	24.0	24.0	24.1	24.1	23.9	23.7	23.7	23.78
22	23.6	23.5	23.4	23.2	23.0	22.8	22.5	22.4	22.3	22.3	22.6	22.5	22.5	22.6	23.2	23.4	23.4	23.6	23.5	23.5	23.5	23.6	23.6	23.6	23.09
23	23.6	23.5	23.4	23.3	23.2	23.0	22.9	22.8	22.8	22.8	22.9	23.0	23.0	23.1	23.3	23.8	23.9	24.0	24.0	24.0	24.0	24.0	24.1	24.1	23.44
24	24.1	24.1	24.0	24.0	23.9	23.7	23.6	23.5	23.3	23.3	23.4	23.6	23.5	23.5	23.7	24.1	24.0	24.0	24.0	24.1	24.1	24.2	24.2	24.2	23.84
25	24.2	24.1	24.0	23.9	23.8	23.6	23.4	23.3	23.1	23.0	23.0	23.1	23.2	23.3	23.4	23.5	23.9	23.9	24.0	24.0	24.0	24.0	24.0	24.0	23.65
26	24.0	24.0	23.9	23.8	23.7	23.6	23.4	23.2	23.1	23.0	23.0	23.0	23.2	23.1	23.1	23.5	23.9	23.9	24.0	24.1	24.0	24.0	24.1	24.1	23.61
27	24.1	24.1	24.0	23.9	23.8	23.6	23.5	23.2	23.0	22.8	22.7	22.8	22.9	23.0	23.0	23.4	23.8	23.9	24.0	24.0	24.0	24.0	24.1	24.2	23.58
28	24.1	24.1	24.0	23.9	23.8	23.6	23.4	23.3	23.1	23.0	23.0	23.0	23.2	23.4	23.5	23.3	23.3	23.3	23.3	23.4	23.5	23.6	23.6	23.6	23.47
29	23.5	23.4	23.4	23.2	23.1	23.0	22.8	22.6	22.5	22.6	22.7	23.0	23.6	23.8	24.2	24.2	24.2	24.1	24.1	24.1	24.2	24.2	24.1	24.1	23.53
30	24.0	23.9	23.8	23.6	23.4	23.2	23.0	22.8	22.7	22.8	22.8	22.9	23.0	22.8	23.0	23.2	23.2	23.2	23.2	23.2	23.3	23.2	23.3	23.3	23.20
31	23.4	23.3	23.2	23.0	22.9	22.8	22.6	22.4	22.2	22.1	22.0	22.2	22.2	22.3	22.5	22.8	23.0	22.9	22.8	22.9	22.9	22.9	22.9	22.9	22.71

Table: Hourly solar chimney room temperature data for October 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	32.0	31.9	31.8	31.7	31.6	31.5	31.5	31.3	31.3	31.2	31.3	31.3	31.4	31.6	32.0	32.2	32.3	32.5	32.7	32.8	32.8	32.8	32.9	32.9	31.97
2	32.7	32.5	32.3	32.0	31.6	31.2	31.0	31.3	31.0	30.0	30.2	30.6	30.9	31.2	31.6	31.5	32.3	31.1	31.0	30.7	30.6	30.3	30.4	30.5	31.19
3	30.7	30.4	30.2	30.0	29.7	29.5	29.2	29.3	29.6	29.7	29.9	30.0	30.3	31.0	31.7	32.3	32.4	32.5	32.0	31.8	31.8	31.7	31.6	31.2	30.77
4	31.5	30.6	30.8	30.8	31.0	31.2	31.3	31.5	31.9	32.0	32.1	32.0	31.8	31.6	31.4	31.3	29.0	29.5	30.0	30.0	30.0	30.0	30.0	30.0	30.89
5	31.0	30.9	30.8	30.7	30.6	30.8	31.0	31.3	31.0	30.0	30.2	30.6	30.9	31.2	31.6	31.5	32.3	31.1	31.0	30.7	30.6	30.3	30.0	29.7	30.83
6	29.9	29.5	29.3	29.0	28.8	29.0	29.8	30.0	30.4	30.7	30.9	31.0	31.2	31.5	32.0	32.5	33.2	32.4	31.6	31.3	31.0	30.7	30.7	30.3	30.70
7	29.9	29.5	29.3	29.0	28.8	29.0	29.8	30.0	30.4	30.7	30.9	31.0	31.2	31.5	32.0	32.5	33.2	32.4	31.6	31.3	31.0	30.7	30.5	30.3	30.69
8	29.9	29.5	29.3	29.0	28.8	29.0	29.8	30.0	30.4	30.7	30.9	31.0	31.2	31.5	32.0	32.5	33.2	32.4	31.6	31.3	31.0	30.7	30.7	30.6	30.71
9	30.2	29.9	29.5	29.2	29.0	28.8	28.5	28.6	28.7	28.8	29.0	29.2	29.5	30.6	31.0	31.7	32.1	32.0	31.8	31.5	31.5	31.4	31.0	30.6	30.17
10	30.0	29.6	29.4	29.3	29.2	29.1	29.1	29.3	29.6	29.8	30.0	30.1	30.3	30.5	30.8	31.0	31.0	30.9	30.9	30.9	30.8	30.6	30.4	30.3	30.12
11	29.9	29.8	29.7	29.5	29.0	28.7	28.4	28.6	28.9	29.2	29.3	29.4	29.7	30.0	30.1	30.7	31.0	31.0	30.7	30.5	30.4	30.3	30.1	30.0	29.79
12	29.4	29.2	29.0	28.9	28.8	28.8	28.9	29.0	29.3	29.4	29.5	29.6	29.9	30.2	30.5	30.8	30.9	30.8	30.4	30.2	30.0	29.7	29.3	28.8	29.64
13	28.4	28.3	28.1	28.0	28.0	27.8	27.5	27.2	27.4	28.1	28.5	28.9	29.7	30.4	30.6	31.4	31.6	31.4	31.0	30.5	30.0	29.7	29.5	29.1	29.21
14	28.8	28.6	28.4	28.3	28.1	28.0	27.9	28.0	28.3	28.4	28.5	28.6	29.0	29.5	29.6	29.7	29.7	29.9	29.8	29.4	29.0	29.0	28.6	28.7	28.83
15	28.1	28.0	27.8	27.6	27.3	27.1	27.0	27.3	27.5	27.7	28.0	28.2	28.5	28.7	29.2	29.4	29.5	29.5	29.3	29.1	29.1	28.6	28.1	27.8	28.27
16	27.3	27.1	27.0	27.0	26.8	26.6	26.4	28.3	26.6	26.7	27.5	27.5	27.7	28.0	28.5	29.3	29.5	29.4	29.1	28.8	28.6	28.5	28.3	28.1	27.78
17	27.7	27.6	27.4	27.3	27.2	27.1	27.0	26.6	26.6	26.8	27.5	28.6	27.6	27.4	27.6	27.8	28.0	28.0	28.0	27.9	27.7	27.6	27.4	27.5	27.50
18	27.3	27.0	26.7	26.6	26.4	26.2	26.0	26.0	26.0	26.1	26.2	26.6	26.9	27.0	27.3	27.5	28.0	27.8	27.6	27.5	27.4	27.4	27.0	26.8	26.89
19	26.2	26.1	26.0	26.0	25.9	25.8	25.6	25.6	25.8	25.9	26.0	26.5	26.8	27.0	27.2	27.4	27.3	27.3	27.3	27.0	27.0	27.0	26.8	26.6	26.50
20	26.7	26.5	26.3	26.2	26.0	25.7	25.5	25.4	25.3	25.4	26.0	26.2	26.8	28.5	27.0	27.0	27.0	26.8	26.5	26.2	26.0	25.8	25.6	25.4	26.24
21	25.5	25.5	25.4	25.3	25.3	25.2	25.2	25.2	25.2	25.3	25.5	25.8	26.0	26.1	26.3	26.4	26.5	26.5	26.4	26.3	26.2	26.1	26.0	25.8	25.79
22	25.3	24.9	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.0	25.8	25.76
23	25.3	25.0	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.0	25.8	25.77
24	25.5	25.2	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.2	26.2	25.81
25	26.4	26.2	26.0	25.4	25.0	24.8	24.5	24.0	24.1	24.3	24.6	25.0	25.2	25.5	26.2	26.4	26.2	25.8	25.7	25.7	25.6	25.6	25.5	25.3	25.38
26	25.1	25.0	25.0	25.0	25.0	24.9	24.6	24.4	24.2	24.3	24.6	25.0	25.5	25.4	25.8	26.0	26.0	26.0	26.0	25.9	25.8	25.8	25.7	25.6	25.28
27	25.0	24.9	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.2	25.8	25.76
28	25.3	25.1	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.2	26.2	25.80
29	26.4	26.2	26.0	25.4	25.0	24.8	24.5	24.0	24.1	24.3	24.6	25.0	25.2	25.5	26.2	26.4	26.2	25.8	25.7	25.7	25.6	25.6	25.5	25.3	25.38
30	25.0	24.9	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	25.9	25.6	25.74
31	24.9	24.5	23.9	23.7	23.6	23.3	23.1	22.9	22.8	23.0	23.5	23.8	24.0	24.2	24.4	24.6	24.9	25.0	25.0	24.9	24.8	24.7	24.6	24.5	24.11

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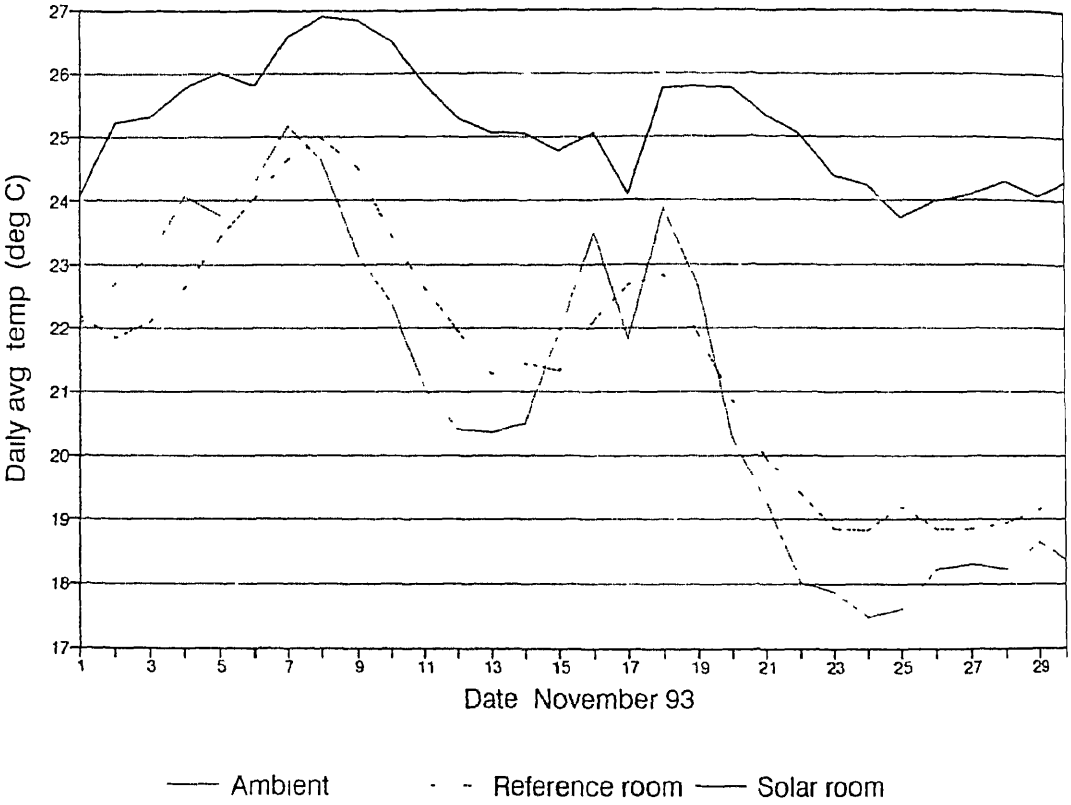

Figure: Comparative performance monitoring of solar chimney system for November 1993

Table: Hourly ambient temperature data for November 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	20.4	19.4	18.5	17.9	16.9	16.1	15.7	15.7	15.9	16.9	21.0	24.1	26.7	27.5	28.7	28.8	28.7	28.5	26.5	25.4	24.3	23.2	21.7	20.9	22.08
2	20.2	19.0	18.5	17.2	17.1	16.9	16.6	16.5	15.6	17.6	22.3	25.7	26.8	29.0	29.2	29.5	29.8	29.7	28.5	29.3	23.7	22.9	22.0	21.1	22.70
3	20.2	19.6	18.8	18.6	17.9	17.7	17.6	17.6	17.9	23.0	25.7	28.9	28.5	28.7	28.7	28.7	28.6	28.5	26.4	24.6	23.2	22.6	21.5	21.1	23.11
4	20.7	21.2	19.4	19.3	19.2	18.3	18.1	18.1	18.2	22.3	25.3	27.3	29.8	30.8	30.8	30.8	30.8	30.4	27.5	25.9	24.8	23.9	22.8	21.8	24.06
5	21.1	20.9	20.0	19.3	18.4	18.4	18.4	18.5	18.8	21.1	23.6	26.1	28.1	27.6	30.6	31.0	31.0	30.7	27.3	28.0	25.1	23.7	22.7	22.0	23.77
6	21.0	20.3	20.0	19.5	19.0	18.3	18.3	18.0	18.2	20.6	24.1	27.2	29.1	31.1	31.2	32.0	31.7	30.6	27.9	26.6	25.6	24.9	24.0	23.4	24.28
7	22.1	21.5	20.6	20.1	19.7	19.2	19.0	18.7	19.0	21.5	25.5	28.5	31.7	32.0	32.7	32.7	32.1	31.3	28.3	27.0	26.2	25.3	24.7	24.7	25.17
8	23.1	22.8	22.6	21.3	20.2	19.4	19.0	19.1	19.4	22.3	24.4	26.6	28.8	30.7	32.1	32.0	31.9	29.4	27.2	25.5	24.5	23.8	22.8	21.7	24.61
9	20.8	20.3	19.5	19.3	18.8	18.1	18.0	17.5	17.7	18.1	22.2	25.5	27.2	28.9	29.7	30.1	30.1	30.0	28.3	25.5	24.2	23.0	21.6	20.7	23.13
10	19.3	18.7	18.2	17.7	17.0	16.3	15.8	15.6	15.8	17.9	21.2	24.6	26.9	29.1	29.5	29.5	29.5	29.2	27.5	26.0	25.3	23.3	22.9	20.7	22.40
11	18.7	18.0	17.2	16.4	15.2	15.1	14.5	14.5	14.4	17.0	21.2	23.2	25.1	26.6	28.0	28.6	28.6	28.4	26.7	24.6	22.1	20.7	20.7	19.7	21.05
12	18.0	17.8	16.9	16.4	15.6	14.8	13.7	13.7	13.3	15.0	19.0	21.6	24.7	26.1	26.7	27.8	28.0	27.8	26.1	23.3	23.0	21.1	20.3	19.4	20.42
13	18.1	17.6	17.5	16.7	16.1	15.9	15.5	15.2	14.6	16.1	18.3	21.1	22.6	24.6	25.0	26.0	26.3	26.2	24.5	23.7	26.3	20.6	20.5	19.6	20.36
14	18.9	17.9	17.7	16.6	16.1	16.1	15.9	15.5	15.6	16.6	19.3	22.4	25.1	25.1	26.0	27.0	27.0	26.6	23.6	21.9	21.9	20.1	19.6	19.6	20.50
15	18.6	18.0	17.1	16.5	16.5	16.5	16.1	15.7	15.7	19.3	23.7	26.7	27.7	27.8	27.7	27.6	27.5	28.1	24.4	23.3	28.7	22.2	21.5	21.1	21.92
16	20.0	20.0	20.0	20.0	19.9	19.8	19.8	19.8	19.8	21.4	25.1	25.9	27.4	28.9	29.5	29.6	29.4	28.6	25.7	24.4	23.1	22.8	22.7	20.2	23.49
17	19.2	18.8	17.4	16.9	16.4	16.0	16.0	16.1	16.1	18.2	21.9	24.9	25.4	27.2	28.1	28.8	28.6	28.3	26.4	24.4	23.3	22.5	21.8	21.2	21.83
18	20.5	20.5	20.5	20.5	20.5	20.6	20.6	20.7	20.8	21.8	25.5	27.5	28.8	28.8	29.5	29.4	29.3	28.9	25.8	24.7	23.5	22.3	21.8	20.6	23.89
19	20.3	19.4	19.2	19.0	18.6	17.6	17.0	16.9	17.0	18.5	23.1	25.7	26.4	27.7	28.7	28.7	28.6	28.2	27.1	25.1	24.4	24.1	21.2	21.1	22.65
20	19.2	19.4	17.7	17.7	15.9	15.6	14.2	14.1	14.1	15.7	19.2	22.1	25.7	25.7	26.4	26.7	26.6	26.4	24.5	22.2	20.9	19.4	18.8	18.1	20.28
21	16.6	16.5	14.9	14.2	14.1	13.9	13.7	13.5	13.6	14.9	20.1	24.8	24.5	24.8	25.0	25.9	25.9	25.7	23.4	22.3	19.8	19.8	17.8	17.2	19.29
22	15.8	14.9	14.8	13.3	12.4	12.3	11.3	11.4	11.4	14.4	17.2	21.0	23.1	23.4	24.8	25.4	25.4	25.4	23.9	21.4	18.9	17.8	16.7	16.4	18.03
23	15.5	15.3	14.3	13.3	12.3	11.9	11.8	11.6	11.7	14.6	17.0	20.4	23.0	23.5	24.5	25.1	25.0	24.9	23.1	21.4	18.7	17.9	16.6	15.5	17.87
24	15.0	14.4	14.0	13.4	12.3	11.4	11.4	10.9	11.0	13.7	17.1	21.5	22.6	23.8	25.3	25.6	25.6	25.4	21.8	19.1	17.6	16.9	15.1	14.6	17.48
25	14.0	12.9	12.1	11.9	11.3	10.8	9.0	9.0	9.2	13.5	17.2	19.9	22.1	24.0	25.4	26.3	26.3	28.0	23.9	23.4	20.3	18.6	18.4	17.0	17.60
26	15.2	14.5	14.5	14.3	13.0	12.6	12.6	11.9	12.0	13.9	16.5	20.0	22.4	23.4	24.3	25.1	25.6	25.4	24.2	22.4	21.3	18.6	17.3	16.6	18.23
27	15.6	15.0	14.3	13.5	12.6	12.4	11.6	11.5	11.5	14.2	17.7	20.6	22.7	24.2	25.3	25.8	25.9	25.9	24.6	22.0	19.9	18.2	17.5	16.7	18.30
28	15.8	15.4	14.4	13.6	12.7	11.8	11.8	11.7	11.6	13.7	17.2	20.6	22.5	24.1	25.0	25.9	26.2	26.1	22.6	20.7	19.7	18.9	18.0	17.6	18.23
29	17.2	15.7	15.2	14.8	13.8	13.0	12.7	12.6	12.6	13.6	17.3	20.5	22.3	24.1	25.7	26.1	26.2	25.8	23.5	21.3	19.6	19.0	17.6	17.4	18.65
30	16.4	15.8	14.8	14.1	13.9	13.6	13.6	13.2	13.1	14.1	17.6	20.1	21.8	23.6	24.1	24.6	24.6	24.6	22.5	20.5	19.7	18.6	18.6	17.1	18.36

Table: Hourly reference conventional room temperature data for November 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	21.9	22.8	22.7	22.6	22.4	22.3	22.1	22.0	21.8	21.7	21.7	21.7	21.8	21.8	22.0	22.3	22.5	22.5	22.4	22.4	22.3	22.3	22.3	22.3	22.19
2	22.3	22.3	22.2	22.1	22.0	21.8	21.6	21.5	21.3	21.2	21.1	21.3	21.4	21.4	21.6	21.9	22.1	22.2	22.2	22.2	22.2	22.2	22.2	22.3	21.86
3	22.3	22.2	22.2	22.1	22.0	21.8	21.7	21.6	21.4	21.2	21.2	21.3	21.4	21.6	22.2	22.4	22.6	22.6	22.8	22.7	22.7	22.7	22.8	22.8	22.10
4	22.9	22.8	22.8	22.7	22.6	22.5	22.4	22.2	22.0	22.0	21.9	21.9	22.0	22.0	22.1	22.4	22.9	23.1	23.0	23.3	23.2	23.3	23.3	23.4	22.61
5	23.4	23.4	23.4	23.3	23.2	23.2	23.0	22.9	22.8	22.7	22.5	22.6	23.0	23.4	23.8	23.8	23.8	23.9	23.9	23.9	24.0	24.0	24.1	24.1	23.42
6	24.2	24.1	24.0	24.0	23.9	23.8	23.7	23.6	23.5	23.5	23.5	23.6	23.7	23.7	24.0	24.5	24.4	24.3	24.3	24.3	24.4	24.5	24.6	24.6	24.03
7	24.6	24.7	24.6	24.6	24.5	24.4	24.3	24.3	24.1	24.1	24.1	24.2	24.3	24.3	24.6	25.0	25.1	25.1	25.0	25.0	25.0	25.1	25.1	25.2	24.64
8	25.2	25.2	25.1	25.1	25.0	25.0	24.8	24.7	24.5	24.4	24.5	24.5	24.6	24.7	24.8	25.1	25.2	25.2	25.3	25.3	25.3	25.3	25.3	25.4	24.98
9	25.4	25.3	25.2	25.0	24.9	24.8	24.6	24.4	24.2	24.0	23.9	23.8	23.9	24.0	24.1	24.3	24.6	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
10	24.4	24.3	24.1	24.0	23.8	23.6	23.4	23.2	23.0	22.8	22.7	22.6	22.6	22.8	22.8	23.3	23.6	23.5	23.6	23.7	23.7	23.7	23.8	23.8	23.45
11	23.8	23.7	23.5	23.3	23.1	23.0	22.8	22.5	22.3	22.1	22.0	21.9	21.9	21.9	21.9	22.0	22.5	22.7	22.5	22.6	22.6	22.7	22.7	22.8	22.62
12	22.8	22.8	22.7	22.5	22.4	22.2	22.0	21.8	21.7	21.6	21.4	21.3	21.2	21.3	21.6	21.8	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	21.96
13	21.9	21.8	21.6	21.4	21.3	21.1	21.0	20.7	20.6	20.6	20.6	20.7	20.8	21.0	21.3	21.3	21.3	21.5	21.6	21.7	21.7	21.8	21.9	21.8	21.29
14	21.8	21.7	21.6	21.5	21.4	21.2	21.1	21.0	20.9	20.9	21.0	21.0	21.1	21.2	21.4	21.6	21.6	21.7	21.7	21.8	21.9	21.9	22.0	21.9	21.45
15	21.9	21.7	21.6	21.5	21.4	21.3	21.1	20.9	20.8	20.8	20.8	20.9	21.0	21.0	21.1	21.3	21.4	21.5	21.5	21.6	21.6	21.7	21.8	21.8	21.33
16	21.8	21.8	21.8	21.7	21.6	21.6	21.5	21.4	21.4	21.4	21.5	21.6	21.8	22.0	22.6	22.7	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.11
17	22.7	22.7	22.7	22.7	22.6	22.5	22.4	22.2	22.2	22.3	22.4	22.5	22.7	22.7	22.9	22.9	23.0	22.9	22.9	22.9	22.9	22.9	22.8	22.7	22.67
18	22.8	22.8	22.8	22.6	22.5	22.3	22.1	22.0	22.0	21.9	22.0	22.0	22.6	22.6	22.7	23.1	23.7	23.7	23.7	23.7	23.8	23.9	23.6	23.2	22.84
19	22.8	22.8	22.7	22.5	22.4	22.2	22.0	21.8	21.7	21.6	21.4	21.3	21.2	21.3	21.6	21.8	22.0	22.0	22.0	21.9	21.9	21.7	21.6	21.5	21.90
20	21.3	21.2	21.0	20.7	20.4	20.1	20.0	19.7	19.9	20.0	20.2	20.2	20.4	20.5	20.7	21.5	22.0	22.2	21.9	21.7	21.6	21.5	21.3	21.0	20.88
21	20.7	20.5	20.0	19.8	19.7	19.6	19.4	19.2	19.0	19.0	19.0	19.5	19.8	20.0	20.2	21.0	20.8	20.6	20.5	20.4	20.4	20.3	20.0	19.8	19.97
22	19.4	19.2	19.0	19.0	18.8	18.6	18.3	18.1	18.0	18.1	18.3	18.6	18.7	19.1	19.7	20.1	20.8	20.8	20.8	20.7	20.6	20.5	20.5	20.3	19.42
23	18.9	18.9	18.7	18.6	18.4	18.2	18.0	17.9	17.9	17.9	18.0	18.2	18.3	18.6	19.2	19.6	19.9	19.9	19.8	19.7	19.5	19.5	19.4	19.3	18.85
24	18.9	18.9	18.3	18.8	18.7	18.6	18.5	18.4	18.4	19.3	18.3	18.5	18.6	18.9	19.0	19.1	19.3	19.2	19.1	19.1	19.1	19.1	19.1	19.0	18.84
25	19.3	19.2	19.0	19.0	18.8	18.6	18.3	18.1	18.0	18.1	18.3	18.6	18.7	19.1	19.7	20.1	20.8	20.7	20.5	20.2	20.0	19.6	19.4	19.1	19.22
26	18.9	18.9	18.7	18.6	18.4	18.2	18.0	17.9	17.9	17.9	18.0	18.2	18.3	18.6	19.2	19.6	19.9	19.9	19.8	19.7	19.5	19.5	19.4	19.3	18.85
27	19.1	18.9	18.3	18.8	18.7	18.8	18.5	18.4	18.4	19.3	18.3	18.5	18.6	18.9	19.0	19.1	19.3	19.2	19.1	19.1	19.1	19.1	19.1	19.0	18.85
28	18.9	18.9	18.9	18.8	18.7	18.6	18.4	18.3	18.2	18.2	18.2	18.3	18.4	18.5	19.0	19.4	19.4	19.5	19.7	19.7	19.8	19.9	19.7	19.6	18.98
29	19.5	19.4	19.2	19.0	19.0	18.9	18.8	18.7	18.6	18.6	18.7	18.7	18.8	19.0	19.3	19.4	19.6	19.7	19.6	19.5	19.5	19.5	19.4	19.4	19.16
30	19.3	19.2	19.0	19.0	18.8	18.6	18.3	18.1	18.0	18.1	18.3	18.6	18.7	19.1	19.7	20.1	20.8	20.8	20.8	20.7	20.6	20.5	20.5	20.5	19.42

Table: Hourly solar chimney room temperature data for November 1993

Date/ hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Average
1	24.4	24.1	23.9	23.7	23.6	23.3	23.1	22.9	22.8	23.0	23.5	23.8	24.0	24.2	24.4	24.6	24.9	25.0	25.0	24.9	24.8	24.7	24.6	24.5	24.07
2	24.9	24.8	24.7	24.6	24.2	24.0	23.9	23.9	24.0	24.0	24.2	25.1	25.2	25.6	26.3	26.8	27.2	26.6	26.3	26.0	26.0	25.8	25.7	25.6	25.23
3	25.0	25.0	24.9	24.6	24.3	24.1	24.0	24.3	24.6	24.9	25.4	25.9	26.0	25.8	25.7	25.8	26.0	26.2	26.0	26.0	26.0	25.9	25.7	25.4	25.31
4	25.0	24.9	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.2	26.2	25.78
5	25.6	25.5	25.4	25.3	25.2	25.3	25.3	25.4	25.3	25.3	25.5	25.7	26.3	26.8	27.2	27.5	27.0	26.8	26.5	26.4	26.3	26.2	26.2	26.1	26.00
6	25.6	25.2	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.2	26.2	25.81
7	26.7	26.6	26.4	26.3	26.0	26.0	25.7	25.6	25.5	25.6	25.7	27.2	27.9	27.4	24.3	27.5	27.9	27.7	27.3	27.0	27.0	27.0	26.9	26.8	26.58
8	27.0	26.9	26.7	26.6	26.4	26.2	26.0	26.0	26.0	26.1	26.2	26.6	26.9	27.0	27.3	27.5	28.0	27.8	27.6	27.5	27.4	27.4	27.3	27.3	26.90
9	26.9	26.6	26.4	26.2	26.0	26.0	25.8	25.6	25.6	25.7	25.8	28.0	28.5	27.5	27.6	27.8	28.0	28.5	27.5	27.0	27.0	26.9	26.8	26.6	26.85
10	26.2	26.1	26.0	26.0	25.9	25.8	25.6	25.6	25.8	25.9	26.0	26.5	26.8	27.0	27.2	27.4	27.3	27.3	27.3	27.0	26.8	27.0	26.8	26.6	26.50
11	25.8	25.3	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.2	26.2	25.83
12	25.9	25.6	25.4	25.2	25.1	24.8	24.6	24.2	24.1	24.3	24.8	25.1	25.3	25.2	25.4	25.6	25.9	26.0	26.0	25.9	25.8	25.7	25.6	25.5	25.29
13	25.3	25.1	25.0	25.0	24.8	24.6	24.5	24.6	24.7	25.0	25.4	25.7	25.4	25.4	25.3	25.2	25.3	25.2	25.1	25.0	25.0	25.1	25.0	25.1	25.08
14	25.3	25.1	25.0	25.0	24.8	24.6	24.5	24.6	24.7	25.0	25.4	25.7	25.4	25.4	25.3	25.2	25.3	25.2	25.1	25.0	25.0	25.0	24.8	24.7	25.05
15	24.6	24.2	23.9	23.6	23.2	23.0	23.0	23.2	23.5	23.7	24.6	25.5	26.7	26.7	27.0	26.4	26.0	25.8	25.5	25.1	25.0	25.0	25.0	24.9	24.80
16	25.3	25.1	25.0	25.0	24.8	24.6	24.5	24.6	24.7	25.0	25.4	25.7	25.4	25.4	25.3	25.2	25.3	25.2	25.1	25.0	25.0	25.0	24.8	24.7	25.05
17	24.4	24.1	23.9	23.7	23.6	23.3	23.1	22.9	22.8	23.0	23.5	23.8	24.0	24.2	24.4	24.6	24.9	25.0	25.0	24.9	24.8	24.7	24.6	24.8	24.08
18	25.0	24.9	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.1	26.0	25.76
19	25.8	25.3	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	25.9	25.5	25.78
20	25.3	25.0	24.8	24.6	24.4	24.3	24.1	24.0	23.9	23.9	24.0	25.0	26.8	28.5	28.1	27.6	27.5	27.6	27.6	26.8	26.5	26.3	26.0	25.8	25.77
21	25.6	25.5	25.3	25.0	25.1	24.9	24.6	24.4	24.2	24.3	24.6	25.0	25.5	25.4	25.8	26.0	26.0	26.0	26.0	25.9	25.8	25.8	25.7	25.6	25.33
22	25.3	25.1	25.0	25.0	24.8	24.6	24.5	24.6	24.7	25.0	25.4	25.7	25.4	25.4	25.3	25.2	25.3	25.2	25.1	25.0	25.0	25.0	24.8	24.5	25.04
23	24.0	23.7	23.5	23.3	23.1	23.0	22.8	22.7	22.7	22.7	22.8	24.1	25.1	26.2	26.6	26.7	26.7	27.0	25.8	25.0	24.8	24.5	24.3	24.1	24.38
24	23.5	23.4	23.3	23.0	23.0	23.0	22.8	22.7	22.5	22.5	22.6	24.0	25.2	26.0	26.4	26.6	26.4	26.1	25.5	25.0	24.9	24.6	24.4	24.2	24.23
25	23.5	23.4	23.2	23.1	23.0	23.0	22.8	22.8	22.7	22.6	22.7	23.3	24.2	25.0	25.3	25.4	25.2	24.7	24.3	24.0	24.0	23.9	23.8	23.6	23.73
26	23.4	23.3	23.2	23.1	23.0	22.8	22.6	22.4	22.3	22.4	22.8	24.3	24.8	25.4	25.6	26.1	26.0	26.0	25.0	24.6	24.2	24.1	24.0	24.0	23.98
27	24.0	24.0	23.8	23.6	23.3	23.2	23.0	22.9	22.7	22.7	23.0	24.2	24.0	24.4	24.6	25.0	25.0	25.3	26.0	25.0	25.0	24.6	24.4	24.4	24.09
28	24.0	23.8	23.7	23.3	23.0	23.0	22.8	22.7	22.5	22.5	22.6	24.0	25.2	26.0	26.4	26.6	26.4	26.1	25.5	25.0	24.9	24.6	24.4	24.2	24.30
29	24.0	24.0	23.8	23.6	23.3	23.2	23.0	22.9	22.7	22.7	23.0	24.2	24.0	24.4	24.6	25.0	25.0	25.3	26.0	25.0	25.0	24.6	24.4	24.1	24.08
30	23.9	23.8	23.5	23.4	23.2	23.0	22.8	22.7	22.5	22.5	22.6	24.0	25.2	26.0	26.4	26.6	26.4	26.1	25.5	25.0	24.9	24.6	24.4	24.2	24.30